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FLOOD PLAIN INFORMATION, CAZENOVIA CREEK, NEW YORK IN THE CITY --ETC(U)
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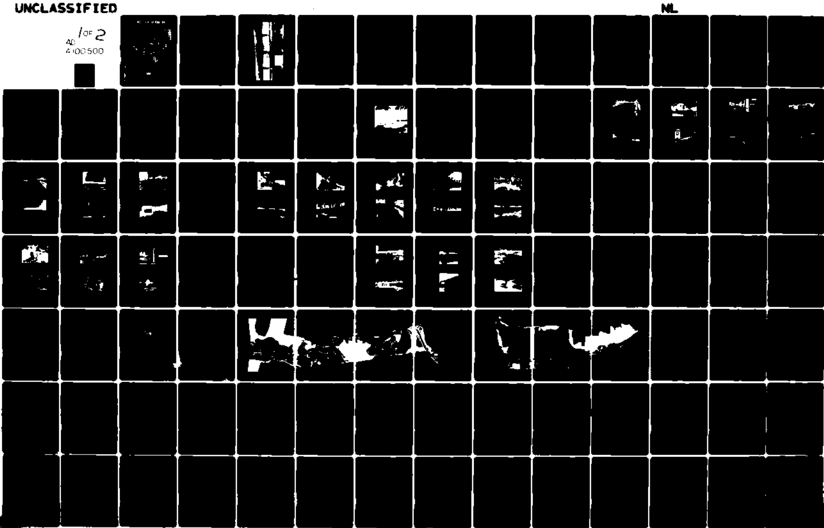


FLOOD PLAIN INFORMATION

CAZENOVIA CREEK, N. Y.

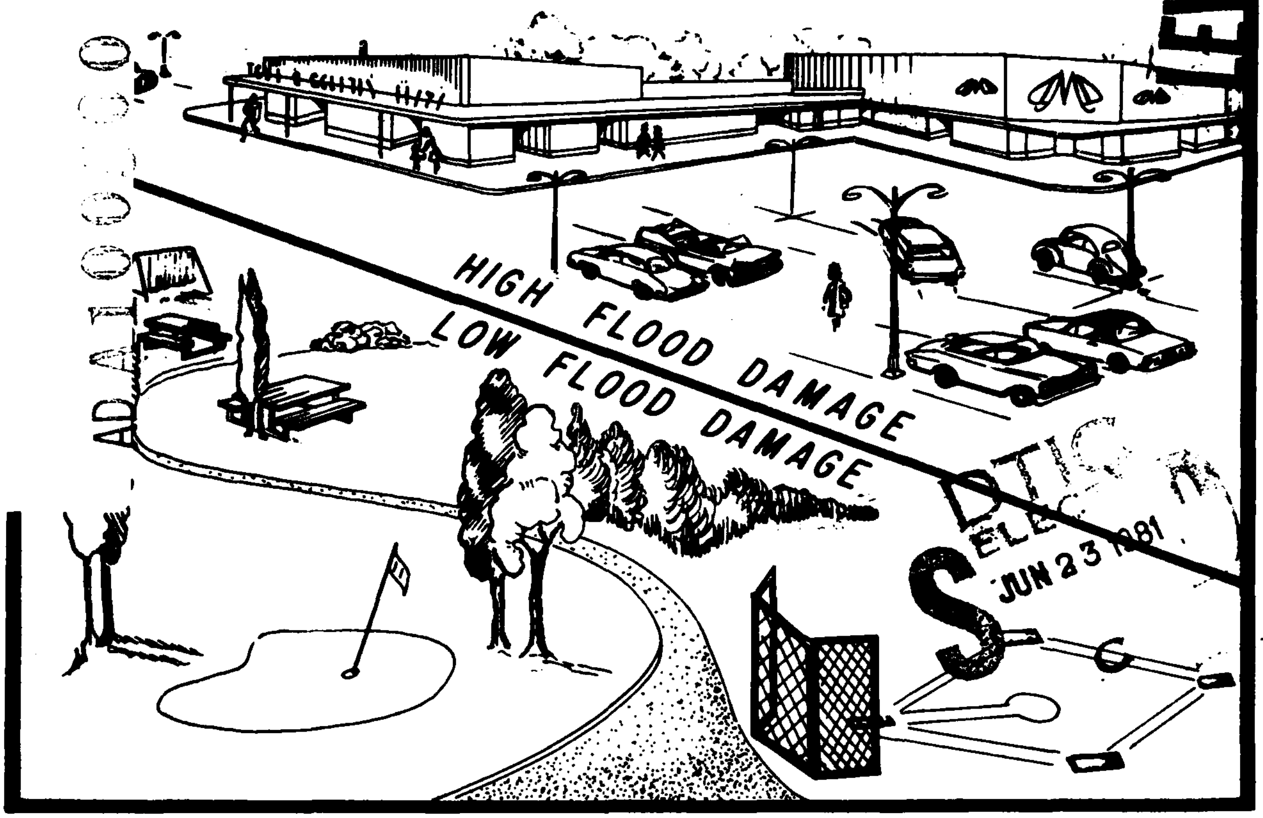
IN THE CITY OF BUFFALO AND TOWN OF WEST SENECA

MAIN REPORT AND TECHNICAL APPENDIX

12

LEVEL

FLOOD PLAINS SHOULD BE UTILIZED — BUT HOW?



PREPARED FOR ERIE COUNTY
WITH COORDINATION OF
STATE OF NEW YORK WATER RESOURCES COMMISSION
AND DEPARTMENT OF PUBLIC WORKS

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OCTOBER 1966 (REPRINTED JUNE 1971)

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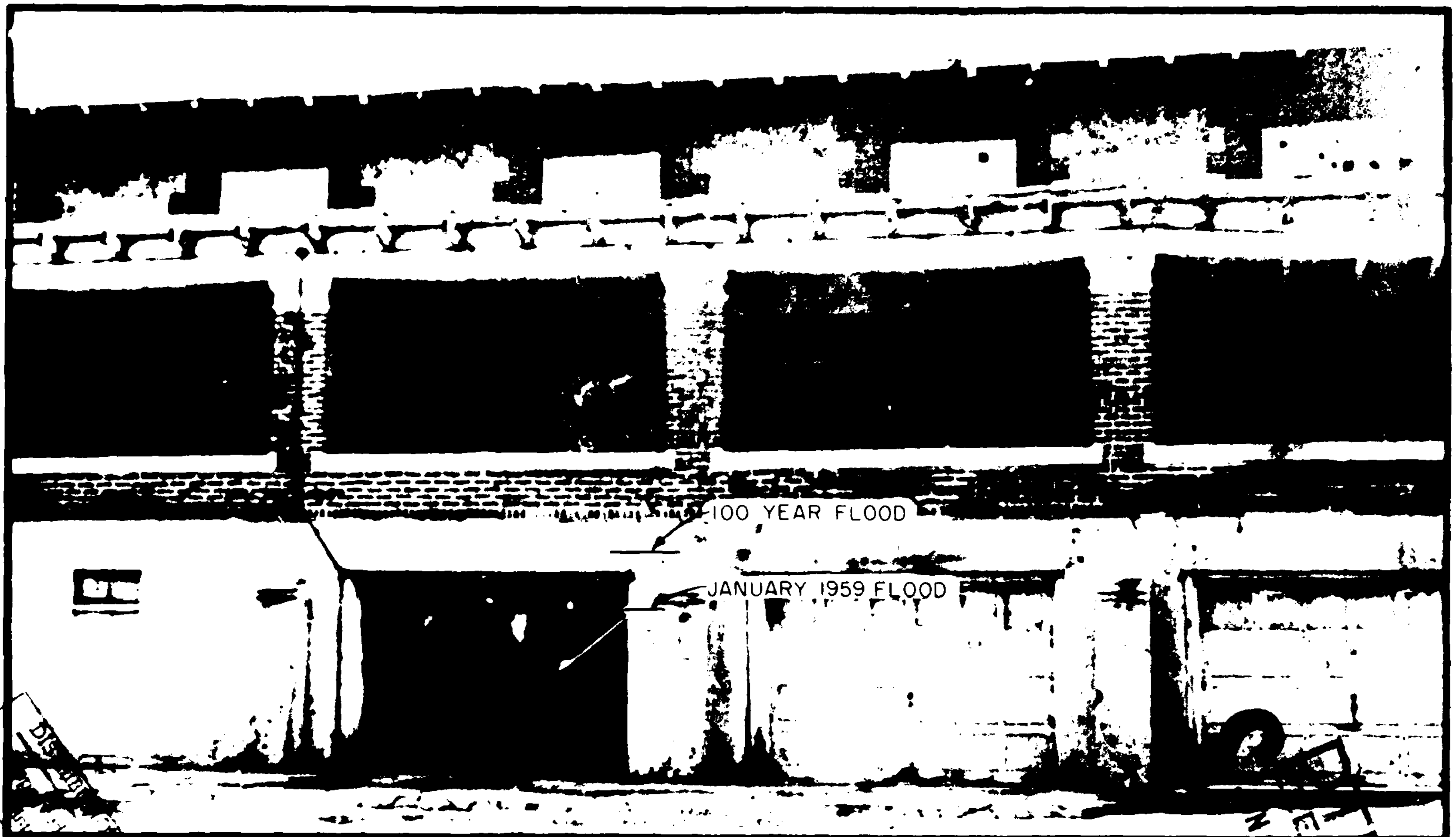
Cazenovia Creek, N.Y.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This flood plain information study covers the inundated areas along Cazenovia Creek from Cazenovia Street in the city of Buffalo to Mill Road in the town of West Seneca. The flood plain area includes portions of the city of Buffalo and the town of West Seneca in Erie County. The study is intended to determine the extent and frequency of past flooding in the area and to provide an estimate of similar data for possible future occurences.



FRONTISPIECE

Flood elevations at the City of Buffalo garage in Cazenovia Park.

FLOOD PLAIN INFORMATION

CAZENOVIA CREEK, NEW YORK
in the
CITY OF BUFFALO AND THE TOWN OF WEST SENECA

MAIN REPORT

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TECHNICAL APPENDIX

The technical appendix of this report was prepared in only a limited number of copies, principally for the use of engineers, designers and planners who have need for detailed technical data. The general public is encouraged to use the reference copies of the appendix which will be available at the locations listed in paragraph 8. Included in the appendix is a list of pertinent bench marks for determining elevations in the flood plain, waterway openings for bridges in the study area, high water mark elevations and explanations of the methods used in deriving the data contained in the report.

PHOTOGRAPHS

PHOTOGRAPHS (Contd)

PHOTOGRAPHS (Contd)

PHOTOGRAPHS (Contd)

SYLLABUS

The following report is directed primarily to two groups of people with an interest in the Cazenovia Creek flood plain study area. First, it is written to provide planners and local governments with technical information on the magnitude and frequency of possible future flooding along Cazenovia Creek. With this information these planners and officials have a basis for effective and workable legislation for the control of land use within the flood plain.

The second group to whom the report is directed consists of the residents within the study area - particularly present and prospective property owners in and adjacent to the flood plain of Cazenovia Creek. In order for flood plain regulations to receive the necessary public support, it is important that residents know the past history of flooding, the purposes and benefits of flood plain regulation and the ways that these regulations can be coordinated with an overall plan of development for the area. Often through ignorance of the flood problem or a disregard of the flood potential, expensive development is allowed to occur in flood plain areas. Federal funds for flood control projects are authorized only when there are sufficient damages from past floods to economically justify the cost of the project. This means that development in a flood plain area may suffer considerable damage before protection can be justified. In the meantime the value of the original development is considerably reduced.

Regulation of flood plain development is a relatively new approach to the problem of preventing flood damages. It consists of first making the local residents aware of the magnitude and frequency of possible flooding. Some of the flood plain areas of Cazenovia Creek are already developed, however, damages can be prevented from increasing by regulating the location and type of future development. This report is designed to provide the general public with information concerning the flood potential and the local governments with data to form a basis for regulatory legislation.

Cazenovia Creek has a history of a number of floods which inundated a substantial area. Since there is every indication that the potential flood threat will increase, the only way to prevent an increase in damages is to prevent an increase in development in the flooded area. It must be understood that flood plain regulation will have little effect on existing damages but is designed primarily to prevent damages that would otherwise occur to future development. Nor does regulation preclude all development in the flood plain but rather recommends its use for recreation areas, parking lots, wild life refuges, and other low damage developments.

Regardless of the location of the flood plain or the overall plan of development for the area, the available methods of controlling future flood plain use and of flood proofing existing developments are generally the same. Therefore information is compiled on methods of flood plain use and flood proofing in an attachment which accompanies the main report. In order to readily distinguish the attachment from the main report, the attachment is printed on green paper.

FLOOD PLAIN INFORMATION REPORT

CAZENOVIA CREEK, NEW YORK

in the

CITY OF BUFFALO AND THE TOWN OF WEST SENECA

GENERAL

1. INTRODUCTION

The Flood Plain Information Report on Cazenovia Creek, New York, has been prepared at the request of the Erie County Department of Public Works. In New York State the Water Resources Commission is responsible for providing policy decisions concerning flood plain study applications and the Department of Public Works is responsible for coordination of the report preparation after the initiating policy decision has been made. By letter dated 17 November 1961 the New York State Department of Public Works requested the Corps of Engineers to consider the application for the Cazenovia Creek study. The study covers approximately 6 miles of Cazenovia Creek from Cazenovia Street in the city of Buffalo to Mill Road in the town of West Seneca, Erie County, New York.

2. The report has been prepared in two parts - the main report and the technical appendix. The main report contains all the available pertinent information on the extent and frequency of flooding and was prepared for the information and use of the general public, local government officials, planning commissions, zoning boards, planners, and developers. The technical appendix contains engineering details and technical data used in the preparation of the main report which may be of value to engineers and designers. The technical appendix was prepared in a limited number of copies and is not included with each copy of the main report. Copies of the appendix are available for reference at several locations within the study area as indicated in paragraph 8.

3. AUTHORIZATION

Authority to prepare this flood plain information report was granted to the Buffalo District, Corps of Engineers, by the Office, Chief of Engineers, under the provisions of Section 206, Public Law 86-645 (Flood Control Act of 1960), as amended. The formal request for study was made by the Erie County Deputy Commissioner of Public Works through the New York State Department of Public Works. Copies of pertinent correspondence and the text of Section 206 are included in the appendix. The report has been reviewed and approved for release by the New York State Department of Public Works and the Office, Chief of Engineers, Department of the Army.

4. PURPOSE OF THE STUDY

It is the intention of this study to provide useful and specific information on past flood occurrences as well as to provide a guide to the extent and frequency of future floods. With this information, State and local agencies may work toward the achievement of the following objectives:

a. To reduce future flood damage through regulation of the use of the flood plain;

b. To preserve adequate floodway and channel clearances;

c. To publicize information for the guidance of private citizens and development interests on the use and hazards of using the flood plain;

d. To reduce future expenditures for projects to protect developments which, in the absence of this information, would have taken place; and

e. To allow maximum use of the flood plain to take place through zoning and other regulation, without detriment to the aforementioned objectives.

5. SCOPE OF THE STUDY

This flood plain information study covers the inundated areas along Cazenovia Creek from Cazenovia Street in the city of Buffalo to Mill Road in the town of West Seneca. The flood plain area includes portions of the city of Buffalo and the town of West Seneca in Erie County. The study area is indicated on plate 1 which is a basin map of Cazenovia Creek. The study is intented to determine the extent and frequency of past flooding in the area and to provide an estimate of similar data for possible future occurrences.

6. Newspaper accounts, stream flow records and interviews with local residents indicate that serious flooding occurred within the study area in June 1937, February 1939, March 1942, March 1955, March 1956, January 1959 and January 1962. Other floods have occurred previous to 1937 but no definite damage values could be established because of the lack of development and records in the area at that time. Because of its relative magnitude and its recent occurrence, the most detailed information is available for the flood of January 1959. This flood is used for reference for the information in this report. The flooded area from the January 1959 flood is shown on plates 2 and 3, and the profile is given on plate 4. To provide an indication of the flooded area that would result from a relatively rare flood occurrence, the approximate outline of the 100-year flood is also shown on plates 2 and 3.

7. USE OF THE REPORT

The information and suggestions contained in this study are presented for the information of the general public of the area and the consideration and use by the New York State Water Resources Commission, the several area Planning Commissions and various other local government agencies. The flooded outlines, profiles and estimated flood frequencies can be used to determine the relative risk of flooding for various areas within the existing flood plain. With this information, future development, either on an individual lot or tract basis, may be planned with due regard for possible flooding. When flood plain regulations are drawn up by local agencies, they can be based on the general guide lines set forth in this report which recognize the need to permit optimum usage of an area without increasing potential flood damage. The flood outlines and profiles contained with this report provide a definite base to which these regulations can be related.

8. This study is not intended to extend any Federal authority over zoning or other regulatory methods, nor does it commit the Federal government to investigating, planning, designing, constructing, operating or maintaining any facilities discussed or imply any attempt to undertake such activity if not authorized by Congress. It is the responsibility of the State and local agencies to disseminate the information in this report to local interests or individuals who have use for such information. The State coordinating agency for the distribution of this study is:

The New York State Water Resources Commission
Conservation Department
Albany, New York 12226

Copies of the main report or main report with technical appendix may be obtained by contacting the following local address:

State of New York Conservation Department
Division of Water Resources
4184 Seneca Street
West Seneca, New York

A limited number of copies will also be available for reference at the following locations:

a. Erie County Department of Planning
255 Ellicott Street, 2nd floor
Buffalo, New York 14203

b. City of Buffalo Division of Planning
202 City Hall
Buffalo, New York 14202

c. West Seneca Town Hall
4620 Seneca Street
West Seneca, New York 14224

Reference copies of the technical appendix will also be available for the use of the general public at the above locations.

9. ACKNOWLEDGMENTS

Considerable information was obtained from among the data developed for the Review of Reports for Flood Control and Allied Purposes on Cayuga, Buffalo, and Cazenovia Creeks, presently being completed. This report is also being prepared by the Buffalo District, Corps of Engineers, and will contain much of the basic data necessary for this study. The cooperation and assistance given by the following agencies, and numerous individuals, in the accumulation of the information used in this report is greatly appreciated. A listing of credits for photographs follows the text of the report.

Town of West Seneca
City of Buffalo
Erie County Department of Public Works
New York State Department of Public Works
Erie County Department of Planning
City of Buffalo Division of Planning
U. S. Weather Bureau
U. S. Geological Survey
New York State Water Resources Commission
Krehbiel-Huffcut-Walters-Guay -- Town of West Seneca Consultants

10. CONTINUING ASSISTANCE OF CORPS OF ENGINEERS

The technical assistance of the Corps of Engineers will be available to State and local agencies to interpret and explain the information contained in this report, particularly as to its use in developing effective flood plain regulations. After local authorities have selected the flood magnitude or frequency to be used as the basis for regulation, the Corps of Engineers can assist in the selection of floodway limits by providing information on the effects of various widths of floodway on the profile of the selected flood. The Corps of Engineers will also furnish technical assistance in developing specific data required in particular areas to carry out an effective regulatory control program. Requests for specific data should first be coordinated through the New York State Water Resources Commission. As further information is available concerning rainfall, runoff, and flood frequencies, the Corps of Engineers can publish addenda concerning any of the information that differs substantially from the data presented in this report. Major revisions should be specifically requested by the coordinating agency.

DESCRIPTION OF PROBLEM

11. GENERAL DESCRIPTION OF THE STUDY AREA

The Cazenovia Creek flood plain study area lies within Erie County, New York. The lower 0.7 miles of the study area are within the city of Buffalo, and the remaining 5.4 miles are within the town of West Seneca.

12. GENERAL DESCRIPTION OF THE WATERSHED

Cazenovia Creek, which is shown on plate 1, is located entirely within Erie County. The creek including its West Branch flows through the towns of Sardinia, Concord, Holland, Colden, Wales, Aurora, Elma, and West Seneca and the city of Buffalo. Cazenovia Creek has the second largest drainage area of the tributaries which form the watershed of the Buffalo River. The two other major tributaries of the Buffalo River are Buffalo Creek and Cayuga Creek. Cazenovia Creek is formed by its East and West Branches which rise near the southern portion of Erie County. The branches flow northerly about five miles apart, and join west of East Aurora. The creek then flows generally northwesterly joining the Buffalo River about six miles above its mouth. The total drainage area is 138 square miles, in the 38-mile length from its source to Buffalo Creek. From its mouth to the confluence of its East and West Branches the Cazenovia Creek basin has the shape of a triangle with the apex at its mouth and its base 3 miles wide at the confluence. From the confluence to its source the Cazenovia Creek basin is rectangular, approximately 8 miles in width and 12 miles in length. The flood plain is relatively narrow and fairly well defined. Through the study area Cazenovia Creek has a relatively steep average slope of 12 feet per mile. Rock is exposed in portions of the channel bottom and at several of the bridges.

13. LAND USE WITHIN THE FLOOD PLAIN

The flood plain within the city of Buffalo shown on plate 2, is completely utilized, including residential areas, a park, and a golf course. The park and golf course are excellent examples of good flood plain planning. The urbanized areas within the city which are occasionally affected by floods are principally residential with about 440 homes, 20 commercial units, and 6 public establishments which have been subject to damages in the past. Within the limits of the study area in the town of West Seneca, shown on plates 2 and 3, there are several residential subdivisions that have been affected by floods in the past. These areas are primarily residential with 130 homes, 2 commercial units, and 7 public establishments having been affected by floods.

14. PROSPECTIVE DEVELOPMENT AFFECTING THE FLOOD PLAIN

The Cazenovia Creek watershed outside the city of Buffalo is not fully developed and the increasing pressure of development moving outward from the metropolitan area will undoubtedly have a noticeable effect. There have been, in the past few years, a residential subdivision and shopping plaza constructed within the flood plain. The entire area in undergoing a definite increase in individual unit development. The population of the town of West Seneca has more than tripled since 1930 and nearly doubled between 1950 and 1960. Population in 1960 was approximately 33,000 in West Seneca. West Seneca has always been among the more developed towns because of its close proximity to the city of Buffalo. The Aurora Expressway combined with the availability of water, sewer and gas throughout the length of Cazenovia Creek will give impetus to both residential and industrial growth and enhance the possibility of developing existing vacant land.

15. As development occurs there are certain factors which affect flood flows and stages in the flood plain area. Increased development and population result in increased and faster runoff from roofs, parking lots, roadside ditches, and storm sewers. Road bridges and creekside fills can, unless regulated, cause restrictions under conditions of high flow. If there is no compensating improvement in the carrying capacity of the natural channel, an increase in development can result only in increased discharges and flood elevations in the flood plain area. Since the flood plain in West Seneca is not fully developed, the purpose of this report is to identify the flood plain and the frequency of flood stages so that future development can make the most effective use of the area without increasing present damages.

16. FLOOD WARNING AND FORECASTING SERVICES

At present there is no specific flood warning or forecasting service for the Cazenovia Creek basin. The area, however, is well within the effective range of the Weather Surveillance Radar operating continuously at the U. S. Weather Bureau, Buffalo Airport Station. This equipment provides for the early detection and plotting of heavy precipitation and makes possible immediate radio and television broadcasts of information concerning the predicted path and amount of rainfall from the storm. The U. S. Weather Bureau has established flood forecasting systems for many of the larger river basins. Accurate forecasting of the timing and stages of flood peaks is difficult on a drainage area as small as Cazenovia Creek.

17. At present there is no definite plan for flood fighting or evacuation in the Cazenovia Creek basin. However the City of Buffalo does attempt to break up ice jams that form in the vicinity of Cazenovia Street, in hopes of lessening the possibility of large ice jams in the spring. In the past blasting and hot water have been used. Since 1962 the City has used amphibious vehicles which are periodically run through the channel to keep it open. The vehicles are shown in operation in exhibit 1. The U. S. Coast Guard has occasionally been requested by the Corps of Engineers to break up ice jams that form in the Buffalo River, thus providing an avenue of escape for ice from Cazenovia Creek. Coordination with other upstream communities such as Ebenezer, East Aurora, South Wales, and Holland would provide an indication of the timing and relative severity of a flooding situation. Reference points and staff gages could be located at one or more of these locations. A water stage recording gage is already established at Ebenezer. Although the anticipated flood may be of moderate proportions, such forewarning permits public utilities, highway departments, and property owners to set up warnings and detours and to reduce flood damage as much as possible. Staff gages that could be used for this purpose have been established by the Erie County Department of Public Works at Cazenovia Street and Orchard Park Road.

18. NATURE AND EXTENT OF FLOOD PROBLEMS

The greatest flood of historical record occurred in June 1937, and other damaging discharges occurred in 1915, February 1939, March 1942, March 1955, March 1956, January 1959 and January 1962. Most of the winter and spring floods have been complicated by ice jams so that resulting flood stages are higher than they would normally be from discharges alone. A condensation of available information on the most notable floods is given in the following paragraphs. This information is given as an example of the type and extent of flood problems which have already occurred and an indication of possible future flood problems. Because of the effects of ice jams along the creek, maximum damages did not occur from the same flood throughout the study area. Damages from a recurrence of these floods are tabulated in table 1, following the descriptions.

a. Jun 1937

This flood is generally considered to be the maximum of record and is the only one of the more notable floods to occur during the summer months. Heavy rainfall was recorded throughout the Western New York area on 17 June and again during 20-21 June. The rainfall of 20-21 June was centered in the eastern suburbs of Buffalo and fell on wet ground in a period of 6 hours. The maximum rainfalls recorded for this period were 3.00 inches at the Buffalo Airport, 2.06 inches at the downtown Buffalo Station and approximately 1.50 inches at South Wales. The few highwater marks obtained indicate

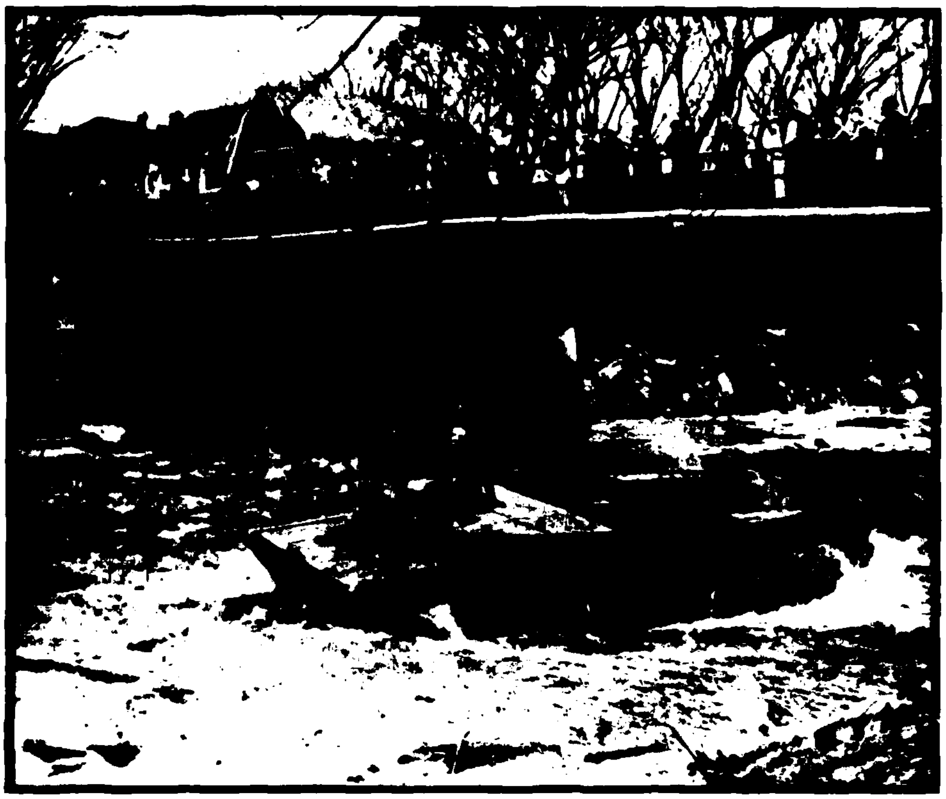

Photo No. 1. City of Buffalo amphibious vehicles breaking up ice jams downstream of Cazenovia Street during the spring of 1964.

that the June 1937 storm caused the highest water levels along the creek for open channel conditions. Damages were estimated at the time of the flood to be approximately $10,600 along Cazenovia Creek. These were primarily agricultural damages and were largely due to erosion. There was little development in the flood plain at the time of the 1937 flood.

b. March 1955

On 1 March 1955, flash floods occurred when heavy rain and thundershowers fell on frozen ground during a six-hour period. Average precipitation over the Cazenovia Creek drainage area was 2.4 inches. Runoff from this storm produced the largest discharge of record at the Ebenezer gage. Examples of flooding from this flood are shown in exhibits 2 and 3.

c. March 1956

Precipitation occurred over western New York State on 5 March from a low pressure system over the area and then on 6 March heavy rainfall occurred during thunderstorm activity. This precipitation was augmented by melting snow and runoff was intensified by frozen ground. Precipitation averaged 2.1 inches over the Cazenovia Creek basin and produced nearly the same discharge at Ebenezer as the March 1955 flood.

d. January 1959

On 21 January 1959, a major storm system from the south central states brought heavy rainfall over Western New York. The precipitation was augmented by snowmelt from a heavy snow cover and the runoff was increased by frozen ground. Flood conditions were further aggravated when the thick ice cover on the stream broke up during the rising water and caused numerous ice jams. Although the 1959 discharge was less, ice jams at some locations created flood levels higher than those of 1955 or 1956. Damage from the 1959 flood in the city of Buffalo, including 440 residential, 20 commercial, and 6 public units was $373,800. This damage resulted from an ice jam upstream of Cazenovia Street which caused flood waters and ice cakes to flow over the street south of the creek, inundating 35 acres of a residential area. Damages from a recurrence of the 1959 flood in the town of West Seneca would be $85,900 which includes 130 residential, 2 commercial, and 7 public units. The profile of the January 1959 flood is shown on plate 4. Exhibits 4 and 5 show examples of damages from the January 1959 flood.

e. January 1962

Damage resulting from the January 1962 flood throughout the study area would have been $210,000, based on January 1959 conditions and January 1966 price levels, but, because of the construction of levees shown on plate 2, since the January 1959 flood, recurrence of the January 1962 stage would now cause no damage below Cazenovia Street and only $13,000 in the remaining flood areas. Although the discharge that caused the flood can be expected to occur on the average of slightly less than once a year, ice jams in the vicinity of Cazenovia Street, Ridge Road and Union Road developed higher stages than other past floods. Examples of post flood conditions from the 1962 flood are shown on exhibits 6 and 7.

f. February 1965

Because damages from this flood were minor, estimates of damages are not shown, but examples of flooding are shown in exhibit 8.

19. EXISTING AND AUTHORIZED FLOOD CONTROL AND RELATED PROJECTS

The Cayuga, Buffalo and Cazenovia Creek watershed was studied in regard to flood control by the Buffalo District, Corps of Engineers in a Survey Report which was submitted to Congress on 23 July 1941. This report recommended a flood control project on Cayuga Creek in the village of Lancaster but found that flood protection elsewhere in the watershed was not justified. A review of the prior survey report was submitted to Congress by the Corps of Engineers on 7 November 1949. Although the report considered improvements for flood control along the lower reaches of all three creeks, there was no feasible local protection project. Another review of the previous reports for flood control and allied purposes is under preparation.

20. On Cazenovia Creek improvements considered consist of localized projects at major damage areas in the study area. If any improvement project is recommended from the study under preparation, the flood limits and profiles in this report can be modified after completion of any project. However, flood plain planning should be based on existing conditions, until the completion, if any, of a flood control project.

21. In 1944 Congress authorized a program of farm-land treatment, and retirement and reforestation of submarginal land for the Buffalo River watershed, including Cazenovia, Buffalo and Cayuga Creeks. The program was started in 1946 as a joint project of the Soil Conservation Service of the Department of Agriculture and appropriate State and local agencies. The program was designed to treat farmland to reduce runoff and erosion and to stabilize stream banks to prevent their erosion. The principal land treatment methods have been

TABLE 1. - Comparative data for floods of record

Flood	Elevation and stage at Ebenezer gage U.S.C.G.S. datum (1)	Peak discharge at Ebenezer CFS	Estimated damage for flood recurren- 19[illegible] price levels and conditions: City of Buffalo	Vic. of Orchard Pk. Rd.	Vic. of Union Rd.	Total
Mar 1942	619.41 (2) 15.11	11,200 (2)	$ 0	$ 6,000	$105,000	$111,00
Mar 1955	620.12 (2) 15.82	13,500 (2)	0	42,000	105,000	147,00
Mar 1956	618.95 14.65	13,000	0	42,000	42,000	84,00
Jan 1959	618.76 14.46	12,600	373,800	17,100	68,000	459,70
Jan 1962	614.69 (2) 10.39	5,400 (2)	0	3,000	10,000	13,00

(1) Gage installed in June 1940.

(2) Stage-discharge relationship affected by ice.

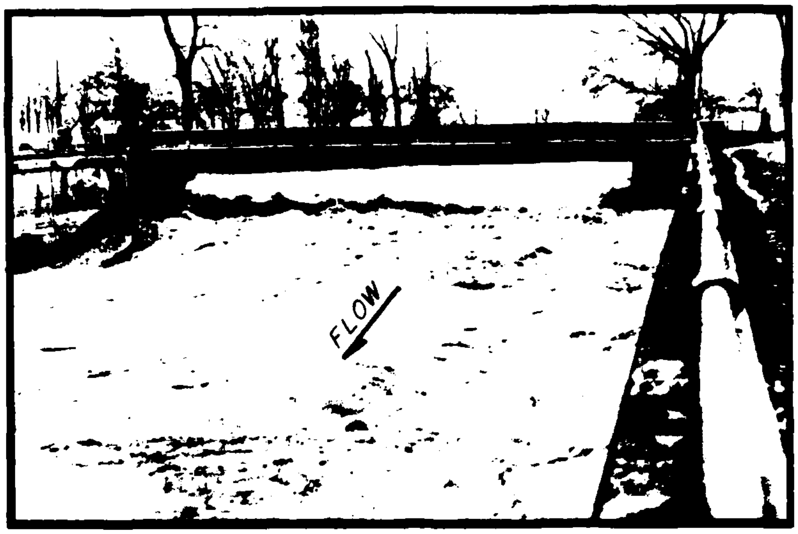

Photo No. 2. High water of March 1955 at the Cazenovia Street bridge, mile 1.2.

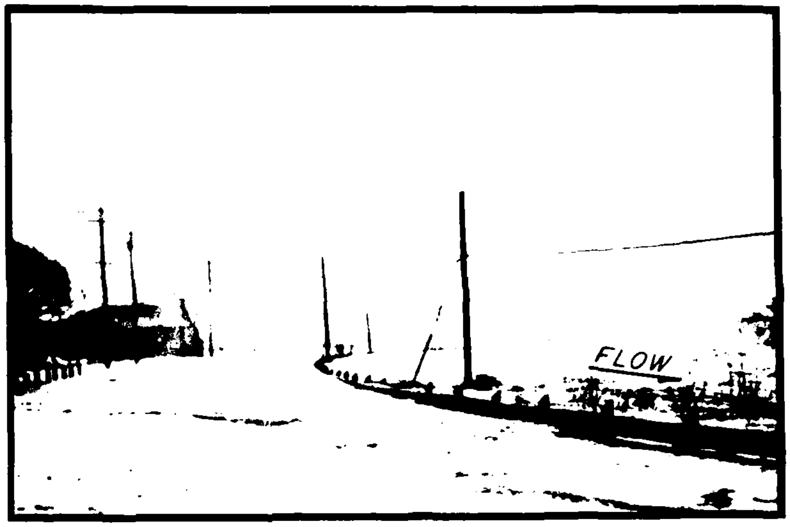

Photo No. 3. Looking upstream toward West Seneca High School on Seneca Street near mile 3.7 during the March 1955 flood. Cazenovia Creek is adjacent to Seneca Street in this photo.

Photo No. 4. The flood of March 1955 surrounding a home on Seneca Street, near mile 4.0.

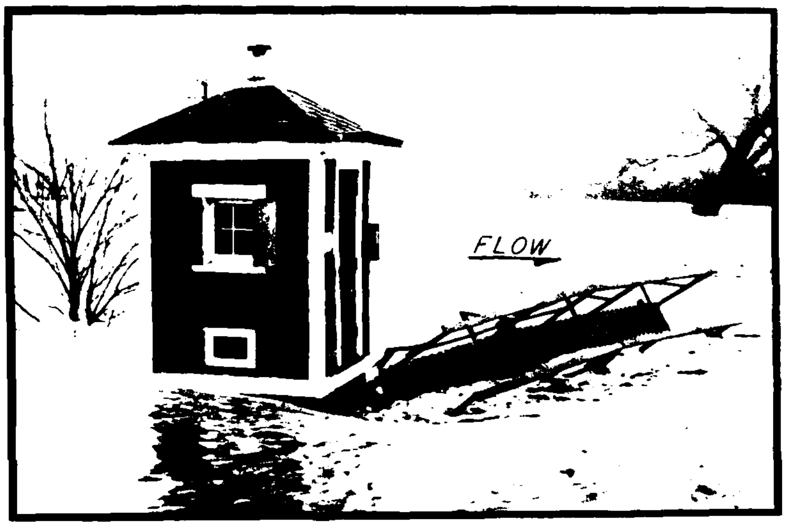

Photo No. 5. Looking from the right to left bank at the gage house, during the March 1955 flood. The gage house is located just upstream of Ridge Road at mile 4.1.

Photo No. 6. The January 1959 flood damage of trees by floating ice of Meriden Street, mile 1.1, in the city of Buffalo. Note ice cakes lodged behind lamp post.

Photo No. 7. Ice jam after the January 1959 flood in the concrete lined section of Cazenovia Creek at mile 1.2 in the city of Buffalo. Ice jam extended to Buffalo Harbor.

Photo No. 8. Ice deposits from the January 1959 flood in the vicinity of Creekward Drive near mile 5.8.

Photo No. 9. Same location as photo No. 8. Note grounded ice cakes and Mill Road bridge in background.

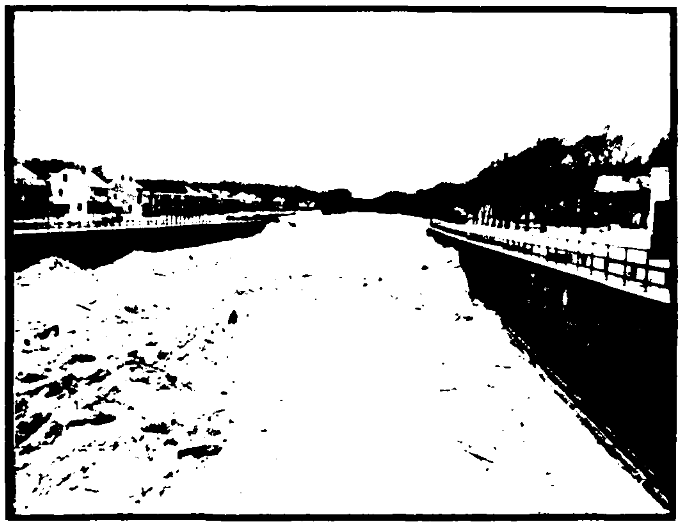

Photo No. 10. Ice jam from the January 1962 flood just downstream of Cazenovia Street in the city of Buffalo.

Photo No. 11. View of ice and debris deposited by the January 1962 flood along Fairfax Drive in West Seneca. Creek is at right of large trees.

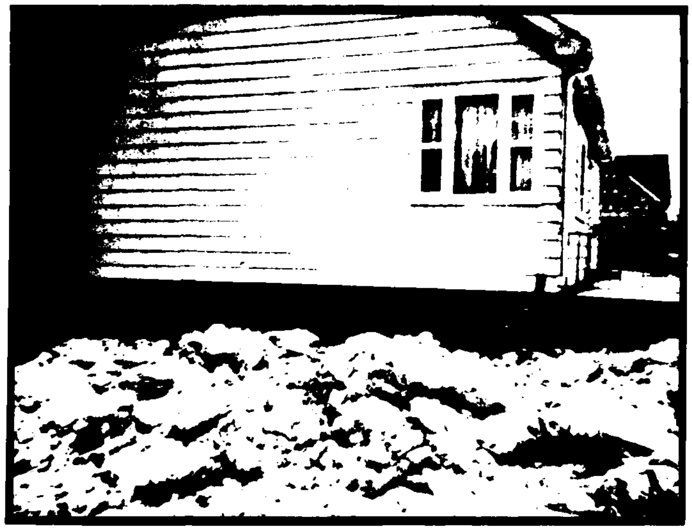

Photo No. 12. Damage from the January 1962 flood along Fairfax Drive in West Seneca, at mile 2.5. Note cave in of basement wall.

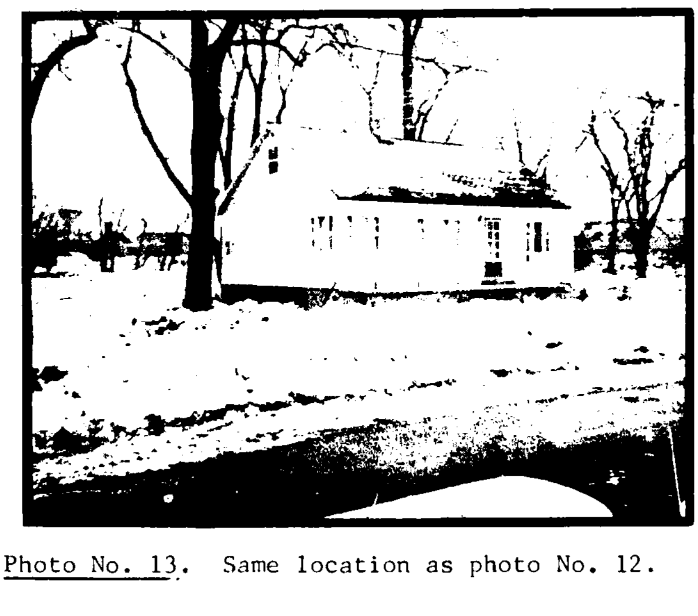

Photo No. 13. Same location as photo No. 12.

Photo No. 14. Looking downstream between Cazenovia Creek and West Willowdale Drive during the January 1965 flood. Area is near mile 5.4.

Photo No. 15. Flood of January 1965 on Mill Road at mile 6.1.

farm ponds, tree planting, planting of retardation crops and strip cropping. The major conservation measures applied on the streams have been streambank protection, channel improvement, levees and water control structures. The general locations of the bank stabilization areas in the study area are shown on plates 2 and 3. Pictures of bank stabilization methods are shown in exhibits 9-10. Although the Cazenovia Creek flood prevention project was officially terminated on 31 December 1963, these conservation practices are continuing to be carried out by approximately 1,160 land owners in the total watershed of the three creeks. From 1960 through 1965 the city of Buffalo sponsored a series of projects in the vicinity of Cazenovia Park that consisted of levees and channel excavation. The levees in the city projects parallel the left bank through most of Cazenovia Park and Golf Course, and protect the residential area along Beyer Street on the right bank. The excavation consists of a channel cut in the rock channel bottom in the vicinity of Cazenovia Street. The channel is approximately 70 feet wide and from 2.8 feet to 9 feet deep. In addition a smaller channel is cut in the 70-foot wide channel mentioned above to concentrate the low flows in a narrow channel and reduce the amount of ice formed. This smaller channel is approximately 15 feet wide and 4 feet deep. Both channel excavations extend approximately 500 feet upstream and downstream of the Cazenovia Street bridge. Other local improvements consist of vertical concrete walls in the vicinity of Cazenovia Street and a levee and stabilization of embankments downstream of Union Road. Exhibits 9-11 show some of the various local improvements.

22. EXISTING REGULATIONS

Although the flood plain of Cazenovia Creek within the city of Buffalo is now either fully developed or being used as a recreational park, including a golf course, zoning regulations would be beneficial for restricting any redevelopment of the area. The park area and golf course are excellent examples of good flood plain development and are shown in photos 22 and 23, of exhibit 12. Other good flood plain developments are shown in exhibit 13.

23. Although zoning regulations have been in effect in the town of West Seneca for a number of years, there are no specific provisions which regulate the use of land with respect to flood risk. The General Provisions of the Zoning Ordinance of West Seneca do indicate that the general goals of the ordinance include: "to secure safety from fire, flood, panic and other dangers." The Stage of New York enabling statutes which permit zoning, specify in the Town Law, Section 263, that "such regulations shall be made in accordance with comprehensive plan and designed to lessen congestion in the streets, to secure safety from fire, floods, panic and other dangers; to promote health and general welfare...." Also Section 277 concerning planning boards and official maps, states that "land shown on such plats shall be of such character that it can be used safely for building purposes without danger to health or peril from fire, flood or other menace."

Photo No. 16. Looking downstream at the Cazenovia Park Golf Course on the left bank of Cazenovia Creek.

Photo No. 17. Looking downstream at levee on the right bank of Cazenovia Creek near mile 5.3. Levee was constructed by contractor before developing residential subdivision as required by the Town of West Seneca.

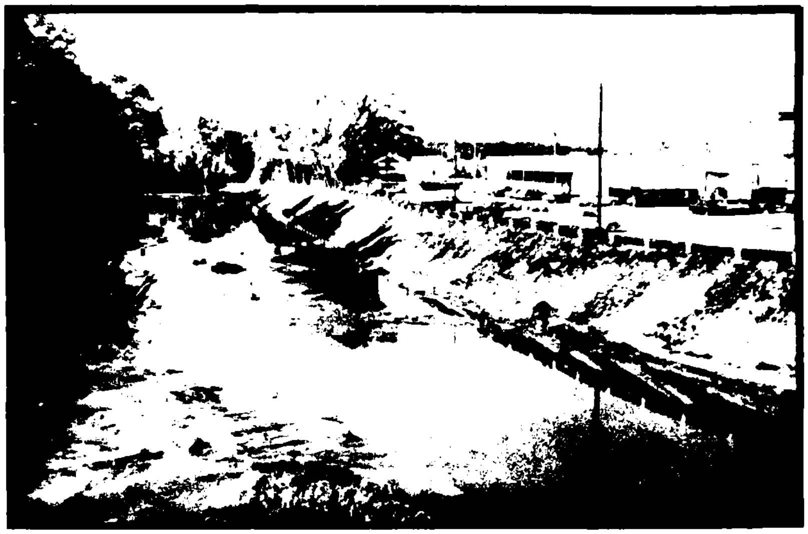

Photo No. 18. Looking downstream from Union Road bridge at concrete-in-bag riprap on right bank at mile 5.5. Riprap was done as part of the development of the Southgate Plaza.

Photo No. 19. Looking downstream on right bank of Cazenovia Creek, upstream of Mill Road mile 6.2 in West Seneca. Bank stability done by Soil Conservation Service.

Photo No. 20. View during deepening of channel at Cazenovia Street by the City of Buffalo in 1964.

Photo No. 21. Looking upstream from Cazenovia Street at improved channel project by the City of Buffalo, at mile 1.2.

Photo No. 22. View of Cazenovia Golf Course which is in the Cazenovia flood plain in the city of Buffalo near mile 1.9.

Photo No. 23. View of Cazenovia Park in the Cazenovia flood plain in the city of Buffalo, near mile 1.3.

Photo No. 24. View of Cazenovia Park and protective levee, mile 1.6, downstream of Green Road in the city of Buffalo. An opening in this levee not shown in this picture, allows flood waters to pond in the park area.

Photo No. 25. Drive-in theater in the town of West Seneca. This area is subject to flooding but has relatively minor damage and is near mile 3.4.

24. The 1965 Legislature of New York State passed amendments adding Part IIIA, Use and Protection of Waters, to Article 5 of conservation law. Part IIIA states, in part, that no person or public corporation shall change, modify or disturb the course, channel or bed of any stream or shall erect, reconstruct or repair any dam or impoundment structure without a permit from the Water Resources Commission. The amendments became effective on 1 January 1966. The full text of the Act can be found in Chapter 955, Sections 429a-g, of the laws of New York State - 1965.

PRECIPITATION AND FLOODS

25. GENERAL

Flooding along Cazenovia Creek is most often caused by thawing temperatures and by rainfall on snow covered or partially frozen ground. Flooding occurs most often in the late winter or early spring. Creek stages are usually affected by ice jams in the vicinity of Cazenovia Street, Orchard Park Road and Union Road. South Wales at Emery Park is the only station located within the Cazenovia Creek basin. In addition, the U. S. Weather Bureau records precipitation, temperature and other data at several stations located near the basin. Several of these near-by stations were used to develop the climatological data for the basin which are summarized in the following paragraph. The stations used are located on plate A1 of the appendix. More detailed data on stations and records are shown in the technical appendix, paragraphs A2-A5 and table A1.

26. CLIMATOLOGY

The average annual precipitation for the stations is 36.92 inches for periods of record averaging 32 years. The monthly averages vary from a minimum of 2.52 inches in February to a maximum of 3.33 inches for May. Annual precipitation is relatively well distributed and about one-third occurs during the first four months when floods normally develop. The average snowfall at the stations recording these data is 82.3 inches. The average temperatures for the basin based on area stations is 46.9 degrees Fahrenheit. January is the coldest month with an average temperature of 24.2 degrees and July is the warmest with an average of 69.2 degrees.

27. STREAM FLOW RECORDS

A water stage recording gage is operated by the United States Geological Survey at a site upstream of Ridge Road in the town of West Seneca. This site was established in June 1940 and records the stages resulting from the runoff from 134 square miles of watershed upstream of that point. The discharge rating curve for this site is well defined by current meter

measurements to a discharge of 7,700 and is shown on plate 16 of the technical appendix. The stage-discharge relationship at the site has often been affected by ice jams which sometimes make it difficult to determine the discharge during a particular flood. The established rating curve is based on open channel conditions at the gage site.

28. FLOOD FREQUENCIES

Floods are random occurrences dependent on a combination of natural climatological factors and channel conditions and there is no method of accurately predicting the time of occurrence or magnitude of any future flood event. However, an analysis of past flood events can give an indication of the probability of occurrence of a given stage or discharge.

29. In connection with flood damages and flood control planning, it is customary to estimate the frequency (or probability) with which specific flood stages or discharges may be equaled or exceeded rather than the frequency of an exact value of stage or discharge. Such estimates are properly designated as "exceedence frequency" but in practice are usually referred to simply as frequency. It should be borne in mind that a so-called 50-year discharge does not imply a 50-year interval between discharges of that magnitude. What is meant is that in a long period of, say, 500 years, this discharge would probably be equaled or exceeded about 10 times, or on the average of once in 50 years. In other words, each year there is a two percent chance that a discharge or stage of at least that magnitude will occur.

30. Along Cazenovia Creek, creek stages are regularly affected by ice jams. For this reason, a rather minor discharge can result in a major flood so that a stage-frequency relationship for the same series of events. Frequency curves for both stages and discharges have been developed for the gage site at Ridge Road and two reference points located at: the upstream side of Cazenovia Street and the upstream side of Orchard Park Road. The locations of these points are shown on plates 2 and 3. Because the drainage areas at the three points are so nearly equal, the discharge-frequency curve for the gage site can be considered adequate for the reference points at the Cazenovia Street bridge and the Orchard Park Road bridge. A discussion of the methods used to develop the frequency curves is presented in the appendix from paragraph A14 through A19. The curves are shown on plate 4.

31. Discharge-frequencies are affected by increased upstream development, additional storm sewers, changes in agricultural practices, etc. Stage-frequencies are affected by ice jams, bridges, channel encroachments, and other natural or unnatural restrictions. Since the frequency data developed for this report are based on a relatively moderate period of record, relationships shown should be revised periodically as more stage and discharge data become available. It is estimated that the effect of future development will produce an increase of less than two percent in the 100-year discharge by 1980. Theoretical floods have been developed in table 2 to show the stages or elevations and discharges which would result at the reference points and the existing gage site from floods of several frequencies. In actual floods on Cazenovia Creek, a stage having a particular frequency will, in most cases, not result from the discharge of the same frequency but will result from some lesser discharge complicated by ice jams.

32. NEED FOR CONTINUING OBSERVATION

The flood profiles and discharge frequency relationships presented in this report have been based both on past flood occurrences and on accepted hydraulic design and hydrology techniques. While the results are considered adequate with respect to the general flood problems and conclusions, it should be emphasized that future data may indicate the need for further study in some localized areas. It is suggested that local interests continue to gather information on high water stages, particularly in the developed reaches in the vicinity of Union Road. It would be useful to have a staff gage located on the upstream side of the Union Road bridge to obtain peak stages during any future highwater occurrences. Comparative stages at existing high water marks would also be helpful in future studies and planning. The Corps of Engineers will also continue to analyze any new data as they are obtained.

33. FLOOD PROFILES AND ESTIMATED LIMITS OF FLOODING

Because of the effects of ice jams, the maximum recorded stages along Cazenovia Creek did not all occur from the same flood occurrence. The greatest amount of data throughtout the study area was available on the flood in January 1959. The limit of flooding as it is estimated to have occurred is shown on plates 2 and 3. The water surface profile for the January 1959 flood is given on plate 4. Because this flood has a relatively frequent chance of occurrence, the estimated flood limits and profiles for a flood of 100-year frequency are also shown on plates 2 and 3. When possible the area affected by the standard project flood is also given to show the extent of the flood plain area that would be affected by a very infrequent storm that can be expected to occur. The standard project flood is the flood produced by the most severe flood producing rainfall that is considered reasonably characteristic of any given basin. The discharge of the standard project flood

at the gage site in West Seneca for Cazenovia Creek was computed to be 77,000 cfs. The flood limits and profile of the standard project flood are not shown, as a flood of this magnitude in the Cazenovia basin would spill over the low divides into adjacent basins in the lower portion of the watershed.

34. The limits of flooding and flood profiles furnished are to provide the local governments with a basis for flood plain regulation. The areas flooded by the January 1959 flood are those normally affected by flooding. The area inundated by the 100-year flood shows the additional effect of a less frequent flood. It must be understood, however, that the limits of flooding as shown are only approximate. Basement flooding from flooded sanitary sewer manholes may extend for a considerable distance beyond the limit of surface flooding. An example of building protective manholes above known flood stages is shown in exhibit 14. Storm sewer design should include the effect of high tailwater caused by flooding conditions. Whenever possible, storm water from high ground should be carried in a separate system from the storm water of the flood plain. This prevents additional water from affecting the low areas at times when the storm sewers are affected by high tailwater. The elevations from the profiles on plate 4 must be translated to the actual ground if an individual wishes to determine the depth of inundation at any given property. This can be done by using standard survey methods and one of the nearby bench marks or high water marks described in the appendix.

35. A tabulation of elevations and discharges which are estimated would result at the reference points from floods of several frequencies is given in table 2. Comparative stages from past floods are also given. Flood elevations for the January 1959 and 100-year floods are shown in exhibits 15 and 16.

TABLE 2. - Estimated stages and discharge at the reference points for floods of several recurrence intervals

Reference point	Theoretical floods: 10 year Disch. cfs	10 year Stage (1) ft.	20 year Disch. cfs	20 year Stage (1) ft.	50 year Disch. cfs	50 year Stage (1) ft.	100 year Disch. cfs	100 year Stage (1) ft.	Actual floods: March 1942 Disch. cfs	March 1942 Stage (2) ft.	March 1955 Disch. cfs	March 1955 Stage (2) ft.	March 1956 Disch. cfs	March 1956 Stage ft.	January 1959 (3) Disch. cfs	January 1959 Stage ft.
Cazenovia St. bridge (5)	11,000	592.0	13,000	594.1	15,500	595.9	18,000	597.0	11,200	585.4	13,500	587.1	13,000	580.1	12,600	(2) 589.0
Orchard Park Road bridge	(4)	605.9	(4)	606.4	(4)	607.1	(4)	607.5	(4)	604.5	(4)	605.3	(4)	605.9	(4)	(2) 605.6
Ridge Road gage site	(4)	619.3	(4)	619.9	(4)	620.8	(4)	622.0	(4)	619.4	(4)	620.1	(4)	618.9	(4)	618.9

(1) Stage frequency relationships based on past history of ice jams.

(2) All stages affected by ice jams.

(3) The January 1959 flood has a recurrence interval of 3 years and is the base flood used in this report.

(4) Since the drainage areas are nearly equal, the discharges at the three points can be considered nearly equal.

(5) Stage frequency curve is based on data collected before channel excavation by the city of Buffalo.

All flood stage elevations are given in feet above mean sea level - U.S.C.&G.S. datum.

Photo No. 26. A built up manhole in the flood plain near Ridge Road. Manhole has been raised to prevent flood waters from entering sewer system.

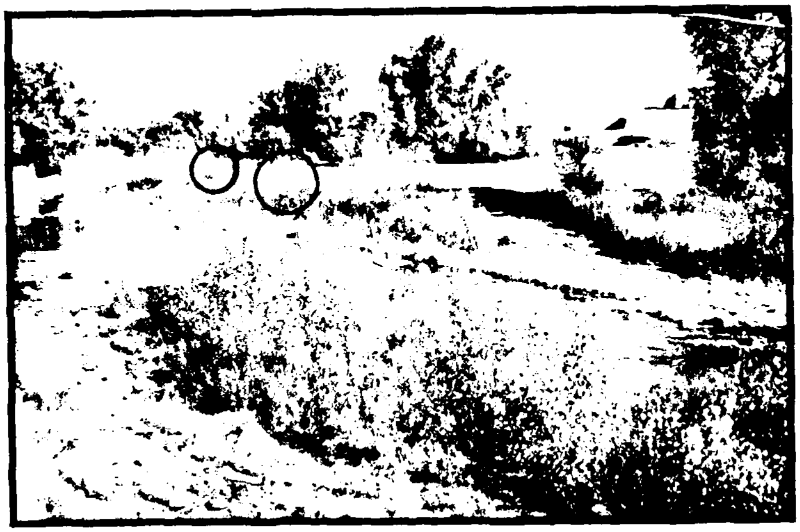

Photo No. 27. Same concept as photo No. 26, with two build-up manholes in the background. The shoal area in the foreground is in the left opening of the Ridge Road bridge on the downstream side.

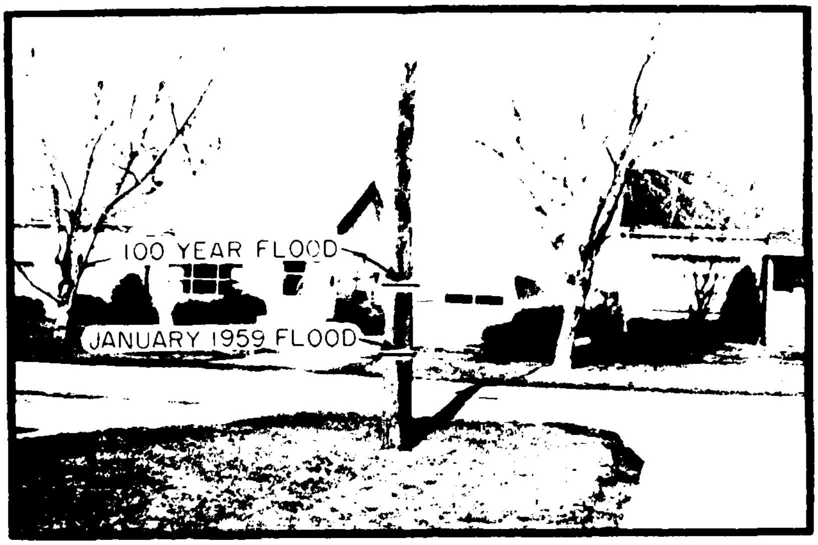

Photo No. 28. Area in the flood plain along Willowdale Drive, showing the January 1959 and 100-year flood elevations. Recurrence of the January 1959 flood would be about 2.7' deep at this point. The 100-year flood is 2.0' higher.

Photo No. 29. Area in the flood plain along West Willowdale Drive showing the February 1965, January 1959 and 100-year flood elevations. Recurrence of the January 1959 flood would be about 3.5' deep at this point. The 100-year flood is 2.0' higher.

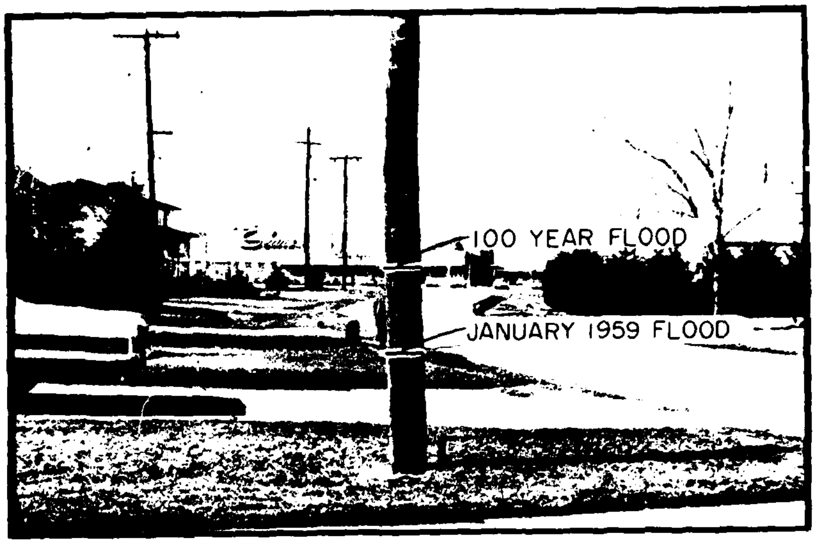

Photo No. 30. Same location as photo No. 28, only with the Southgate Plaza in the background.

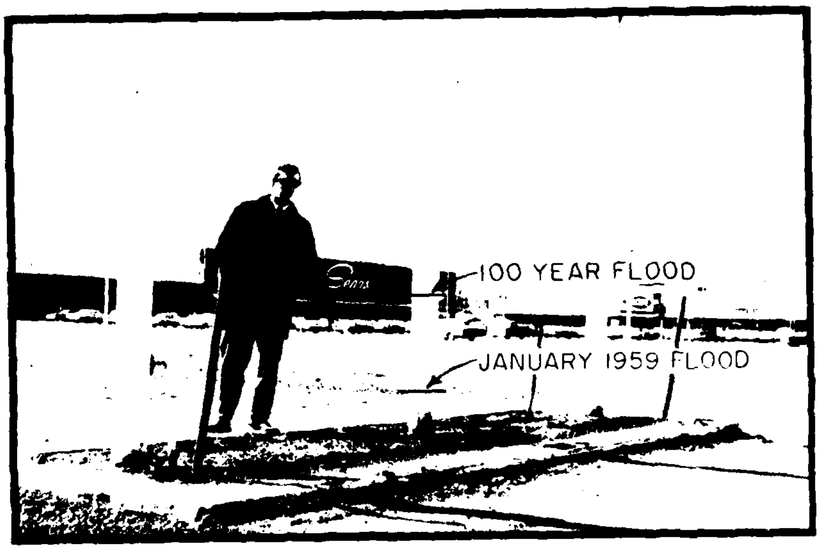

Photo No. 31. The January 1959 and 100-year flood elevations shown on the sign post in the Southgate Plaza. Recurrence of the January 1959 flood would be about 1.0' deep at this point. The 100-year is 2.0' higher.

36. HIGH WATER MARKS

A tabulation of the high water marks obtained throughout the study area for the January 1959, and other various floods are given in table 8 of the appendix. These established highwater marks will be useful to planners, engineers, contractors and others concerned with flood elevations along the Cazenovia Creek. Approximate locations of the high water marks are shown on plates 2 and 3. Profiles of future floods can easily be added to plate 4 by observation of peak levels during floods at the same locations as the high water marks already established. The new flood elevations can be determined by simply measuring up or down, as the case may be, from the known high water mark elevation.

GUIDE LINES FOR THE USE OF THE FLOOD PLAIN AND FOR REDUCING FUTURE FLOOD DAMAGES

37. GENERAL

The total damages along Cazenovia Creek have been extensive because of the concentrated development and the relatively frequent flooding. The Cazenovia Creek watershed has an abundance of available vacant land at the present time but is in the line of population movement from metropolitan Buffalo to the south and east. In spite of the history of past flood damage, the flood plain will probably remain attractive for residential and commercial development. Some control on either the development or the creek will be necessary to prevent a large increase in flood damages as future development increases.

38. Flood damages can be prevented or reduced by two basic approaches. Damages to existing development can be reduced by flood control. Broadly speaking, it consists of exercising control over the stream in time of flood. Dams and reservoirs can be used to store water to be released after the threat of flooding has passed. Channel improvements can be used to remove constructions and improve flow characteristics so that future flood stages are reduced. Levees, dikes and flood walls can be constructed to confine the creek to a definite course at stages which may be well above the adjacent flood plain. These methods are generally very costly and therefore are used in areas where floods are frequent and damages to existing development are heavy. Estimated average annual benefits from a considered flood control project must be at least equal to the estimated average annual costs of the considered project including interest, amortization, and maintenance.

39. Damages to future development can be prevented by flood plain management. This consists of exercising control over the land lying adjacent to the creek that is subject to flooding. The need for flood plain planning along Cazenovia Creek should be recognized by local interests before the flood plain is completely developed. The flood plain information study can provide the data on which flood plain management can be based. Damage to future development in the study area can be reduced or eliminated, at little or no cost to the taxpayer, by the legislation of flood plain regulations which prevent developments of a type or in areas which would make them subject to damage. At the same time these regulations should encourage and promote the maximum effective use of the flood plain area by developments which sustain a minimum of damage.

40. Regulation of the flood plain can be carried out most effectively by a combination of several of the available methods - encroachment lines, zoning ordinances, subdivision regulation, and modifications or additions to existing building codes. These methods will be described in more detail in the attachment which follows this report. However, it is not within the purpose of this report to recommend the specific technique to be used. Flood plain regulations are the right and responsibility of local governments and they must decide the most suitable and effective method for their area. The Erie County Planning Board has done considerable research into the present and projected growth in the several townships of the County in the areas of land use, population, economy, transportation, and recreation. Both the town of West Seneca and the city of Buffalo have planning boards. Using the flood data in this report, in conjunction with a definite planning program for future land uses, will enable these and other local interests to permit maximum flood plain use consistent with minimum flood damage risk.

41. FLOOD PLAIN REGULATIONS

Flood plain regulation involves the establishment of legal tools with which to control the extent and type of future development which will be allowed to take place within the flood plain. The regulatory controls have the broad purposes of (1) protecting existing development in the flood plain from additional damage by the control of activities which would increase existing flood stages and frequencies and (2) controlling future development in areas where potential flood hazards are known to exist. For these controls to be effective, it is necessary that there be public understanding of the general problem, degree of risk and the available alternative actions. Without such public understanding, regulatory controls may be ignored or challenged in the courts. Unrealistic ordinances are sometimes cast aside because no clear distinction has been made between the

right to use one's property at his own discretion, and the obligation of each individual to act in accordance with the general public safety. The regulations must also be specific enough that criteria, such as minimum first floor elevations, type of construction or encroachment limits are known for the area in question. Finally, it should be emphasized that any flood plain regulations can only be as effective as their enforcement.

42. There are basically two main objectives of regulation. The first is to assure and guarantee the retention of an adequate floodway for the river - - - floodway being defined as that area required to pass a flood of a specific size without unduly raising upstream water surface elevations. The areas lying on either side of the floodway, and which may become inundated by this specific flood, are commonly called restrictive zones. Although the restrictive zones may experience flooding, their areas are not necessary to carry the discharge of the selected flood, but rather serve as storage or backwater areas of low velocity. After the local agencies concerned have selected the magnitude or frequency of the flood which will be used as a basis for control legislation, the Corps of Engineers can provide the necessary technical assistance required to compare the effects of various widths of floodway on the profile of the selected flood.

43. There are several natural and man made sections along Cazenovia Creek which have an effect on water surface elevations during high discharge periods. Consideration should be given to modifying the condition whenever possible, removing the restrictive structure when it has outlined its usefulness or replacing it with a less restricting structure, when replacement becomes necessary. Removal of channel obstructions is very important and should be done annually by local agencies. The location of several shoals that have an effect on high discharges and ice jams are shown in exhibits 17-19.

44. Comparative openings of the bridges over Cazenovia Creek within the study area are given in table A5 of the appendix. The profile for the 1959 flood shown on plate 4, indicates that there may be constrictions at several bridge crossings. Pictures of some of the bridges are also shown on exhibits 17-19.

45. At the present time there is a sewer crossing at Orchard Park Road which extends above the natural channel bottom approximately 3 feet. Shoal areas have formed at the upstream end of the pool and ice floes and debris are easily grounded. A picture of this crossing is shown in photo number 35.

Photo No. 32. The Lehigh Valley Railroad bridge and N.Y.S. Thruway bridge at mile 2.4. Note the shoal area and that the bridge piers are staggered. Both conditions restrict the flow of the creek and collect debris and ice.

Photo No. 33. View of twin railroad bridges at mile 3.3. Note the partial blockage of the right opening by a shoal.

Photo No. 34. View of N.Y.S. Thruway bridge at mile 2.4. Note the large shoal area that has blocked much of the bridge approach.

Photo No. 35. Looking upstream under the Orchard Park Road bridge at mile 2.6. Note the damming effect of a sewer line that has been laid on the channel bottom and covered with concrete.

Photo No. 36. Looking upstream at Ridge Road bridge at mile 4.1. Note the shoal area that has build up blocking almost the entire right span.

Photo No. 37. Looking downstream at Mill Road bridge at mile 6.1. A large shoal area has built up here blocking almost the entire width of the bridge opening.

46. There are some abrupt bends in Cazenovia Creek, several of which probably contribute to ice jams and high water stages in the area. These bends are shown on plates 2 and 3. One of the worst bends is located at mile 3.6 just upstream of the New York Central Railroad bridge. This bend has been produced by nature and reduction of the bend would not be difficult, due to the vacant land available. However, any man made modifications of the flood plain, which tend to increase the sharpness of these bends or restrict the channel, should be avoided.

47. The second objective of regulation is to encourage sound land use within these restrictive zones, consistent with the flood hazard and the community land use needs. The flood profiles on plate 6 are the key or foundation for this aspect of regulation. For example, if local planners decide that future residential development should be protected from flood elevations a given number of feet higher than the January 1959 flood, flood plain regulations should be referenced to that profile. Building codes, subdivision regulations or zoning ordinances should specify the minimum allowable elevation for first floor, basement slab, or building site (whichever is selected). <u>The minimum allowable elevations should be given in terms of a specified distance above the January 1959 profile at the nearest point to the construction site - - the January 1959 profile being defined by the profile and high water marks contained in this report. The January 1959 flood stage near Ridge Road has a frequency of about once in 8 years</u>. Photograph 31 of exhibit 10 shows a shopping plaza which for the most part was constructed after the January 1959 flood. A recurrence of the January 1959 flood would cause significant damage to this shopping plaza. The damage would be due to about one foot of water and ice over the parking lot and about six inches of water in some of the stores.

48. REDUCTION OF FLOOD LOSSES BY FLOOD PROOFING

In addition to flood plain regulations for future developments there are several methods of flood proofing structures which may be helpful to those persons who are already located in the flood plain. Flood proofing is the use of structural modifications and adjustments to property for the purpose of reducing flood damages. It is most often carried out on an individual basis and is generally not a part of an enforced flood plain regulation program. Residents in the South Buffalo and Ebenezer areas may be particularly interested in this phase of flood damage reduction since some of them have already suffered damage several times. description of several flood proofing methods and an illustrative exhibit are included in the separate attachment following the main report.

[illegible]

In 1960 an Erie-Niagara [illegible] plan [illegible] through the coordinated efforts of [illegible] County [illegible] Department and the Niagara County Planning Board. [illegible] of this Regional Plan, Outdoor [illegible] Recreation, provides review of the existing recreational facilities [illegible], some criteria and standards for recreational [illegible] and prediction of recreational land needs for the future. [illegible] recreation report [illegible] accepted guide for recreation [illegible] of one acre per 100 persons. [illegible] probable future regional population of 2,100,000 for the year 2000, recreational requirements would be 21,000 acres. [illegible] region had approximately 4,900 acres of park land in 19[illegible]. The 1960 population for the region [illegible] about 1,[illegible] means that there should have been more than 8,[illegible] acres of park land available at that time [illegible] of the existing population.

50. Included within these recreational land requirements [illegible] be many acres which need little or no [illegible] development. Existing flood plain lands can be easily utilized for [illegible], picnicking, nature trails, overnight camping, etc., with negligible increase in damage potential. State assistance for land acquisition is available under a $100,000,000 bond issue program. At present there are no plans for future recreational parks along Cazenovia Creek within the study area of this report, although there are several locations that would make ideal parks. There is within the City of Buffalo a recreational park and golf course that utilize the flood plain of Cazenovia Creek. These facilities begin at Cazenovia Street, which is the lower end of the study area and extend to the town of West Seneca.

51. [illegible] FLOOD CONTROL MEASURES

Because of the concentrated development within the flood plain area of Cazenovia Creek, flood damages throughout the whole area have been relatively heavy. Corps of Engineers studies under preparation are considering improvement plans to provide adequate protection on Cazenovia Creek in the major damage reaches. A review of problem areas by local interest may show that some minor improvement may provide a substantial amount of benefit to the immediate area even though occasional flooding could still occur.

[illegible]

Th[illegible] County Planning Department and the planning boards of [illegible] and the City of Buffalo are aware of the problems of the flood plain. [illegible] have been mad[e] through the Erie County Planning Department on present economic and population growth trends and the resulting needs for housing, recreation facilities, schools, utilities, and transportation. The population of Erie County is expected to be 25 percent greater in 1[illegible] than it was in 1960. West [Seneca], which is in the first suburban ring around Buffalo, should [experience] an incr[ease] of more than 40 percent by 1980 [illegible] population of [illegible],000. As a result the Cazenovia [illegible] will be subjected to increasing pressures for development [illegible] without adequate regulation some of this development would undoubtedly occur in areas subject to flooding. The comprehensive plans for development in West [Seneca] provide for the establishment of green belt areas along [Cazenovia Creek]. Carrying out these considerations would provide for much needed recreation areas and hold future [illegible] to a minimum.

[illegible] would [illegible] to unrestricted future development [illegible] by regulatory controls. These regulatory controls should provide for the optimum use of the [illegible] with the minimum risk of flood damage. The [illegible] this report provide[s] [illegible] can be [formu]lated. Public awareness of the potential flood [illegible] and public acceptance and [illegible] of the flood plain regulations can prevent any significant rise in the existing damage potential with little direct cost to the area. This [illegible] may also serve to reduce [illegible] in the existing development through flood pro[ofing] of existing structures and by reducing existing channel restrictions by providing more adequate bridge areas, removal of dams, etc., when the existing structures have [illegible] their useful life.

[PHOTO CREDITS]

Frontispiece - Buffalo District, Corps of Engineers

[illegible] - Buffalo [illegible]

[Nos]. [illegible], 14, 1[illegible] - Historical Society of West Seneca

[Nos]. 6 through [illegible], 11 - [U. S. Dept.] of Agriculture, Soil Conservation Service

[Nos]. [illegible] - Buffalo District, Corps of Engineers

GLOSSARY OF SELECTED TERMS

A. HYDROLOGIC TERMS

1. Channel - A natural or artificial watercourse of perceptible extent, with definite bed and banks to confine and conduct continously or periodically flowing water.

2. Crest gage - A gage which leaves a record of the highest stage occurring during a particular flood. The gage usually consists of a hollow pipe anchored vertically in the stream channel. Flood water rising within the pipe leaves a mark at its highest elevation by means of crumbled cork or dye floating on the surface of the water within the pipe.

3. Discharge measurement - A method of determining the total discharge past a given point in a stream during actual flow conditions. The method requires the use of a velocity meter, and an accurate measurement of the cross sectional area of the flowing stream, from the stream bottom to the water surface. The most reliable rating curves are obtained by plotting measured discharge vs observed stage at the time of measurement over a wide range of flows.

4. Flood - A temporary rise in stream flow or stage that results in significant adverse effects in the vicinity under study.

5. Flood stage - A term commonly used by the U. S. Weather Bureau and others to designate that stage, on a fixed river gage, at which overflow of the natural banks of the stream begins to cause damage in any portion of the reach for which the gage is used as an index.

6. Flood frequency - A means of expressing the probability of flood occurrence. It is customary to estimate the frequency with which specific flood stages or discharges may be equaled or exceeded, rather than the frequency of an exact stage or discharge. Such estimates are properly designated "exceedence frequency" but in practice are usually referred to simply as "frequency". The frequency of a particular stage or discharge is usually expressed as occurring once in a specified number of years; or as a percent - the percentage being numerically equal to the average number of occurrences in 100 years.

7. Flood peak - The highest value of the stage or discharge attained by a flood;thus peak stage or peak discharge.

8. Flood of record - Any flood for which there is reasonably reliable data useful in technical analyses. Often the term is used to refer to "maximum flood of record."

9. Flood plain - The relatively flat low lands adjoining a watercourse or other body of water subject to overflow therefrom.

10. Flood profile - The longitudinal profile traced by the crest of a flood event expressed in elevation.

11. Gage - (See Recording and Staff gage).

12. Green belt - A term related to the development and retention of stream frontages and flood plains as "green belts." Permissive use of these public or private lands for certain agricultural uses, parks, golf courses, and similar uses would materially reduce or regulate the damage potential in the frequently affected portion of the flood plain area.

13. Historical flood - A known flood which occurred before systematic record keeping was begun for the stream or area under consideration.

14. Natural floodway - The channel of the stream or body of water and that portion of the flood plain that is used to carry the flow of the flood.

15. Rating curve - (See Stage-discharge curve).

16. Recording gage - Any gage which records stage heights continuously so that a permanent record is produced showing the river stage vs time. The mechanism usually consists of a drum revolving at constant speed and an inking pen whose movements are activated by the fluctuating river stage.

17. Recurrence interval - The average interval of time, based on a statistical analysis of the past record, which can be expected to elapse between floods equal to or greater than a specified stage or discharge. Recurrence interval is generally expressed in years.

18. Staff gage - A graduated scale anchored permanently in a vertical position within a stream channel, so that the height of the water surface can be read directly on the scale.

19. Stage-discharg curve - (Rating curve) A graph showing the relation between the gage height, usually plotted as ordinate and the amount of water flowing expressed as volume per unit of time, usually cubic feet per second, plotted as abscissa. A rating curve is applicable only to the given location on the river for which it was developed.

20. Standard project flood - The flood produced by the most severe flood-producing rainfall that is considered reasonably characteristic of the drainage basin under study.

21. Thalweg - The elevation of the deepest part of a stream channel at any section. When determined at many sections along the length of a stream, it provides a profile of the bottom from mouth to source.

B. REGULATORY TERMS

1. Building code - A collection of regulations adopted by a local governing body setting forth standards for the construction of buildings and other structures for the purpose of protecting the health, safety and general welfare of the public.

2. Designated floodway - A channel of a stream and that portion of the adjoining flood plain designated by a regulatory agency to provide for reasonable passage of flood flows.

3. Encroachment lines - Lateral limits or lines along streams or other bodies of water, within which no structure or fill may be added. Their purpose is to preserve the flood carrying capacity of the stream or other body of water and its flood plain, and to assure attainment of the basic objective of improvement plans that may be considered or proposed. Their location, if along a stream, should be such that the floodway between them including the channel will handle a designated flood flow or condition. These lines are set by regulatory agencies and may be changed by them.

4. Flood plain regulations - A general term applied to the full range of codes, ordinances, and other regulations relating to the use of land and construction within flood plain limits. The term encompasses zoning ordinances, sub-division regulation, building and housing codes, encroachment laws and open area regulations.

5. Flood proofing - A combination of structural changes and adjustments to properties subject to flooding primarily for the reduction or elimination of flood damages.

6. Selected regulatory flood - The magnitude of flood expressed either in discharge or frequency of occurrence, which is used as the basis for flood plain regulations.

7. Subdivision regulations - Regulations and standards established by a local public authority, generally the local planning agency, with authority from a State enabling law, for the subdivision of land in order to secure coordinated land development, including adequate building sites and land for vital community services and facilities such as streets, utilities, schools and parks.

8. Zoning ordinance - An ordinance adopted by a local governing body, with authority from a State zoning enabling law, which under the police power divides an entire local governmental area into districts and, within each district, regulates the use of land, the height, bulk, and use of buildings or other structures, and the density of population.

C. OTHER TERMS

Urban Renewal - The overall program of public and private action, growing out of the National Housing Act of 1954 as amended, designed to prevent the spread of blight, to rehabilitate and conserve urban areas that can be economically restored, and to clear and redevelop areas that cannot be saved.

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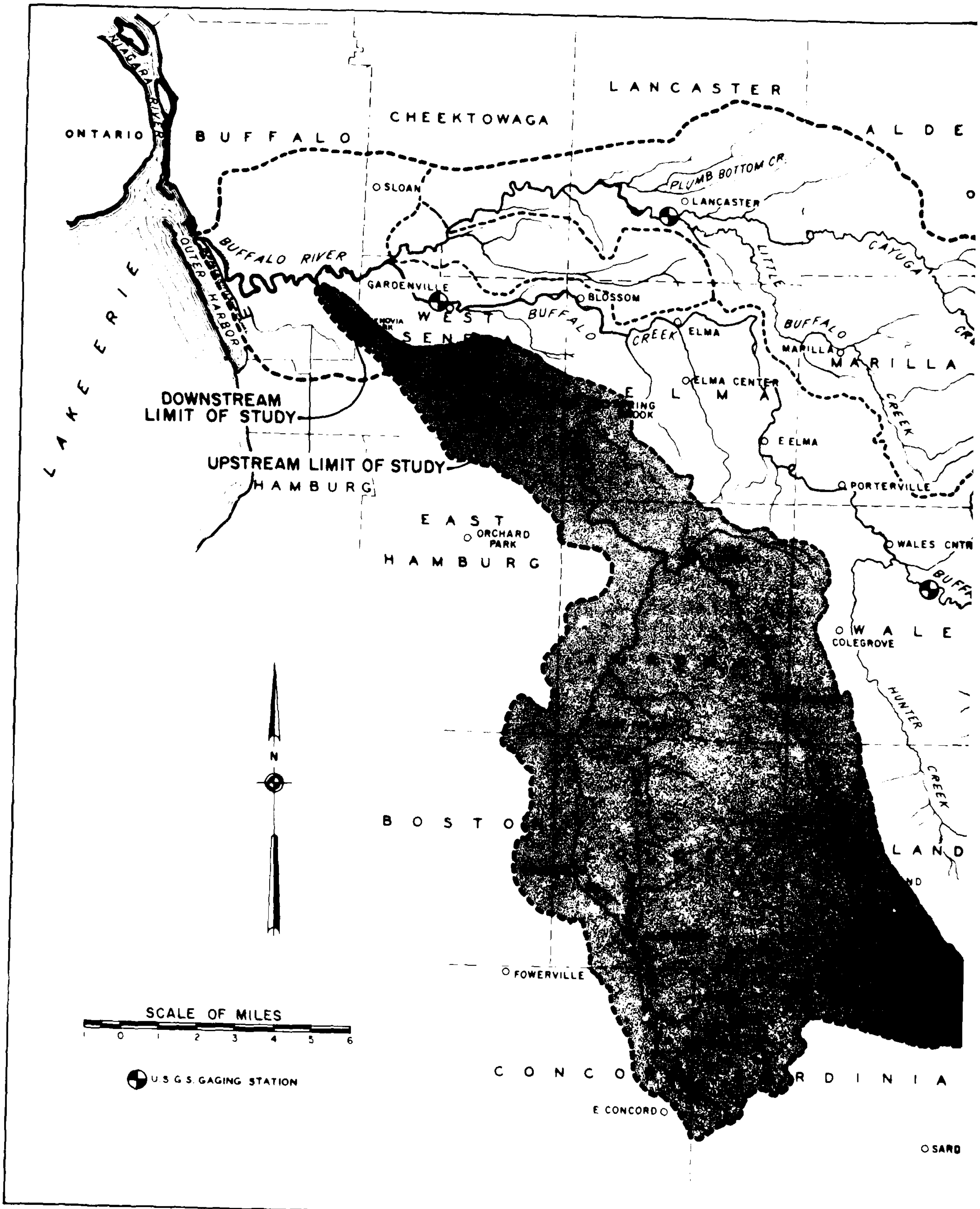

LANCASTER
CHEEKTOWAGA
ONTARIO
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NIAGARA RIVER
PLUMB BOTTOM CR.
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OUTER HARBOR
LAKE ERIE
CAYUGA
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GARDENVILLE
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MARILLA
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ELMA CENTER
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DOWNSTREAM LIMIT OF STUDY
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UPSTREAM LIMIT OF STUDY
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PORTERVILLE
EAST
ORCHARD PARK
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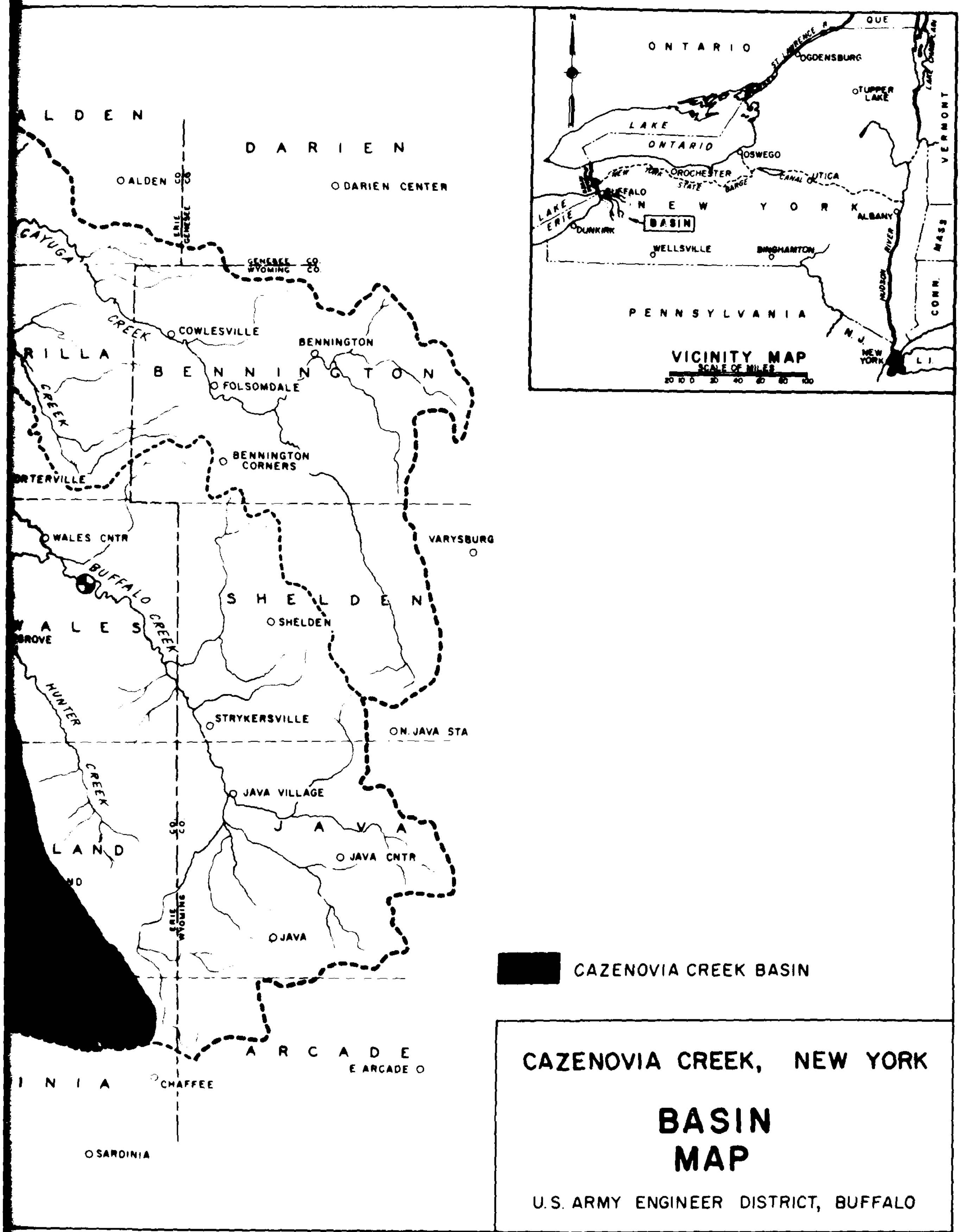
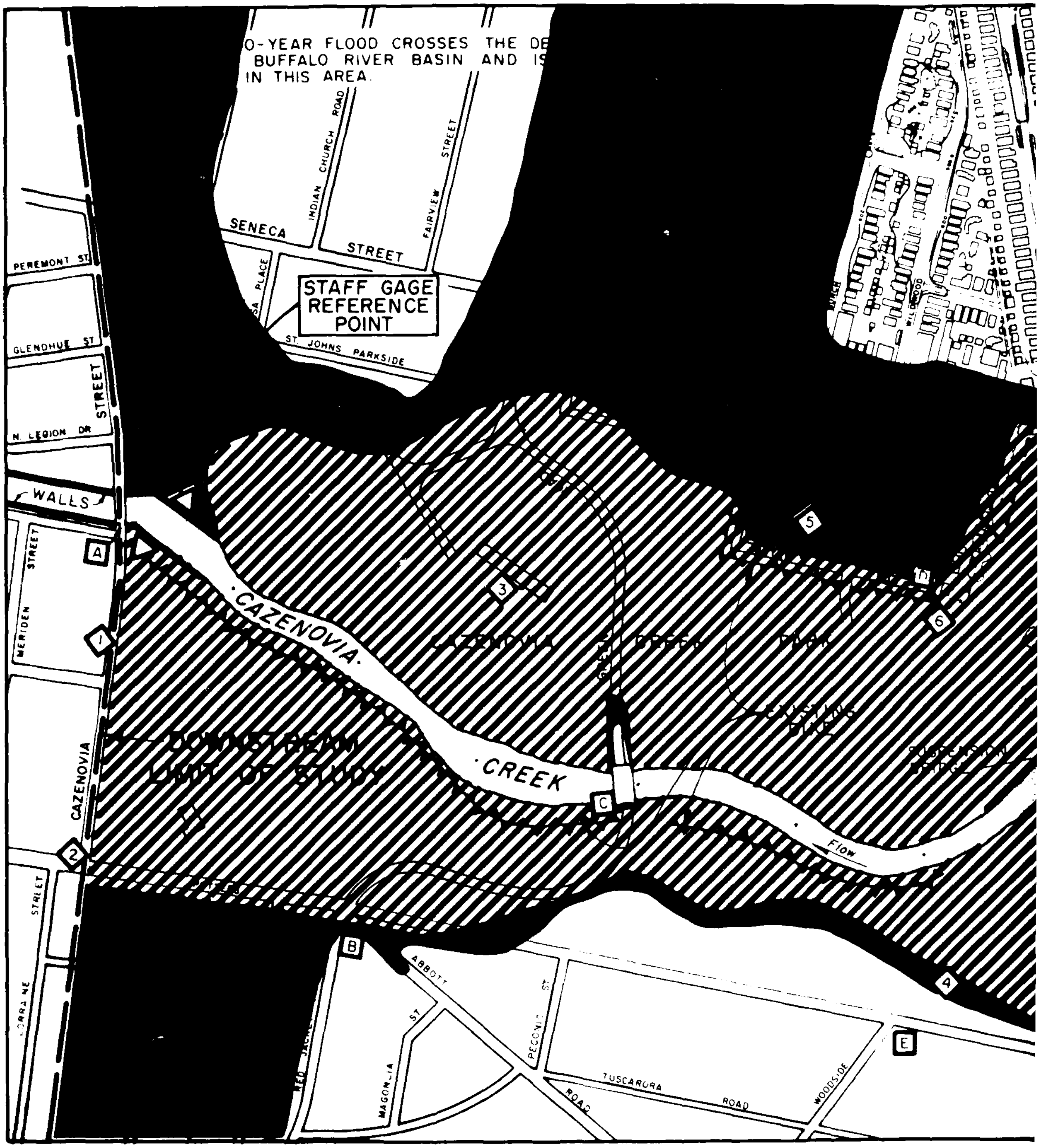


CAZENOVIA CREEK, NEW YORK

BASIN MAP

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 1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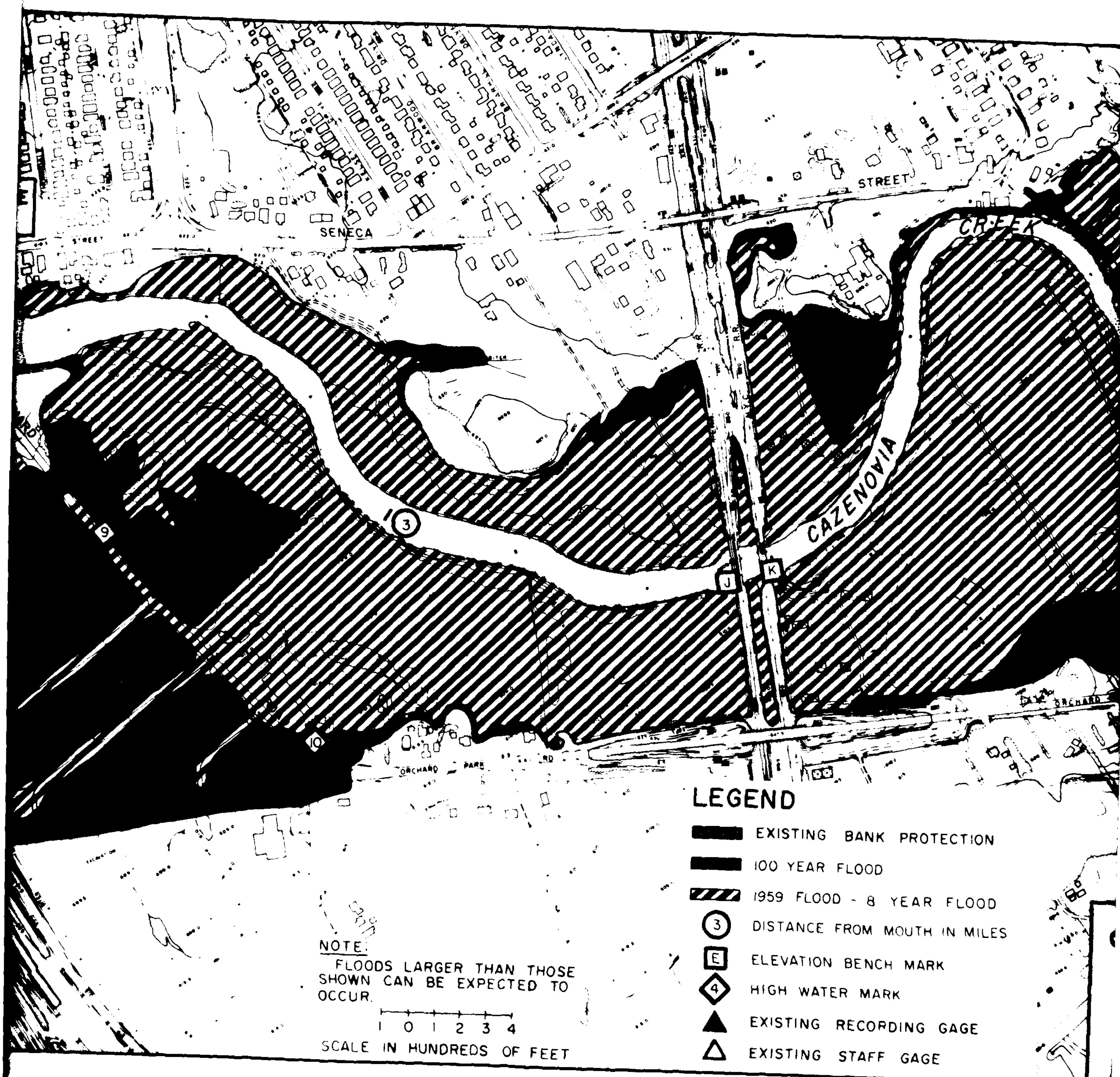
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E ELEVATION BENCH MARK
4 HIGH WATER MARK
EXISTING RECORDING GAGE
EXISTING STAFF GAGE
NOTE:
FLOODS LARGER THAN THOSE SHOWN CAN BE EXPECTED TO OCCUR.
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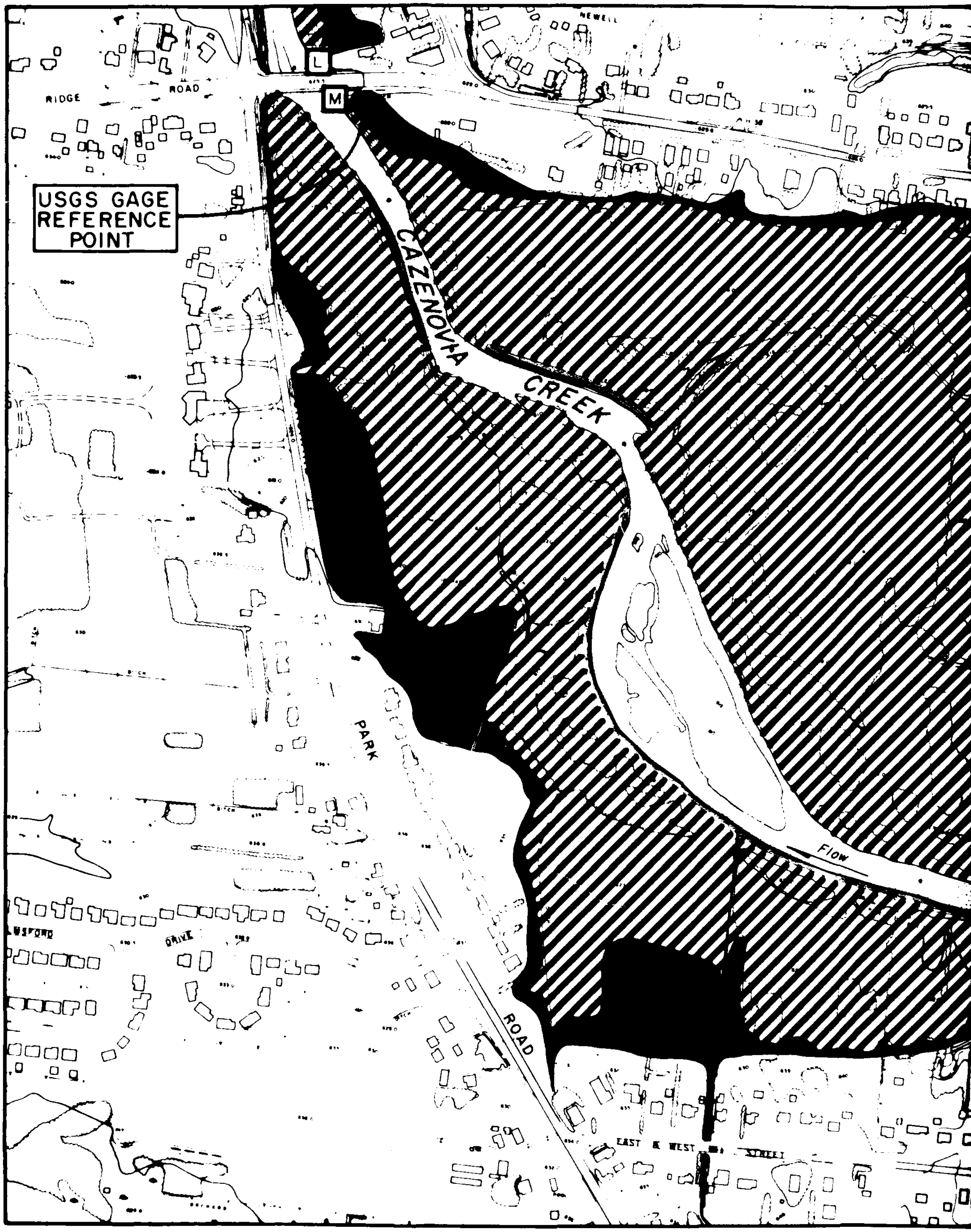
SCALE IN HUNDREDS OF FEET

CAZENOVIA CREEK, NEW YORK

FLOODED AREAS MILE 1.2 TO 4.1

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 2



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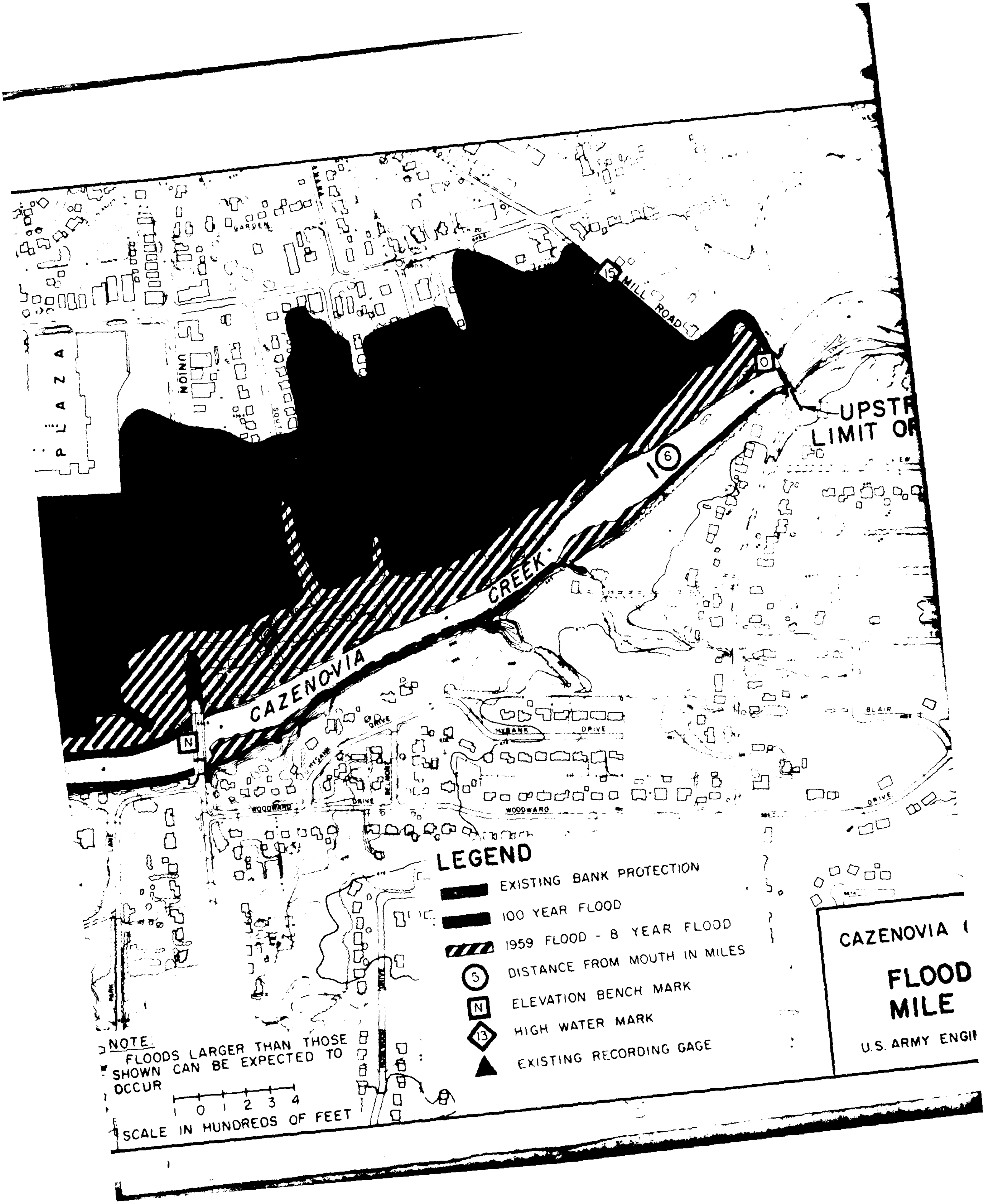

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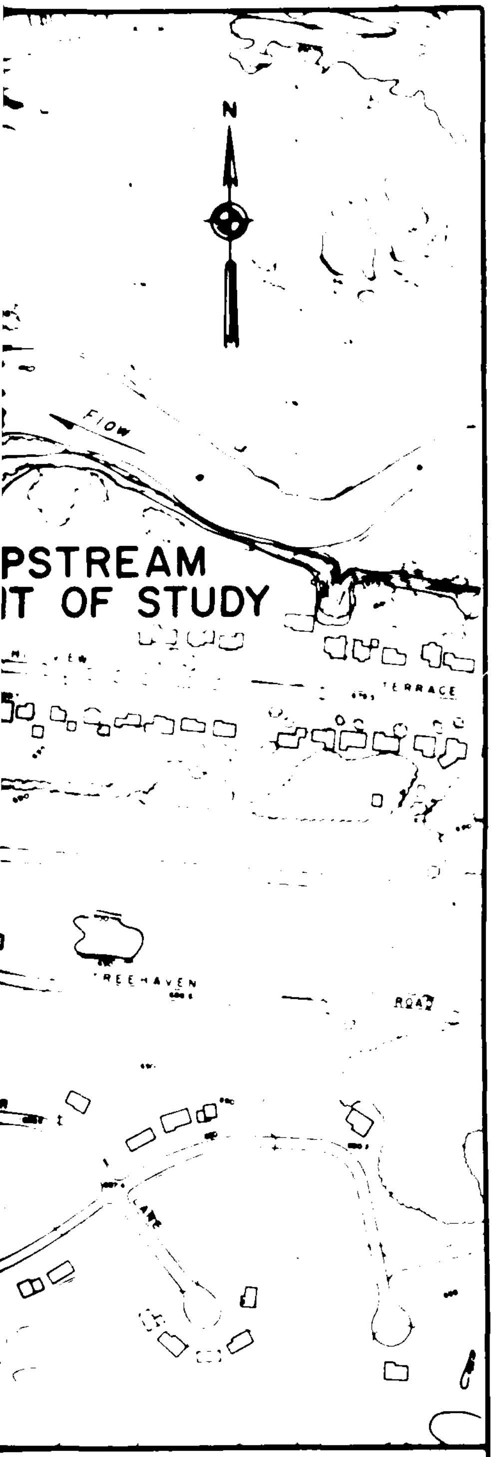
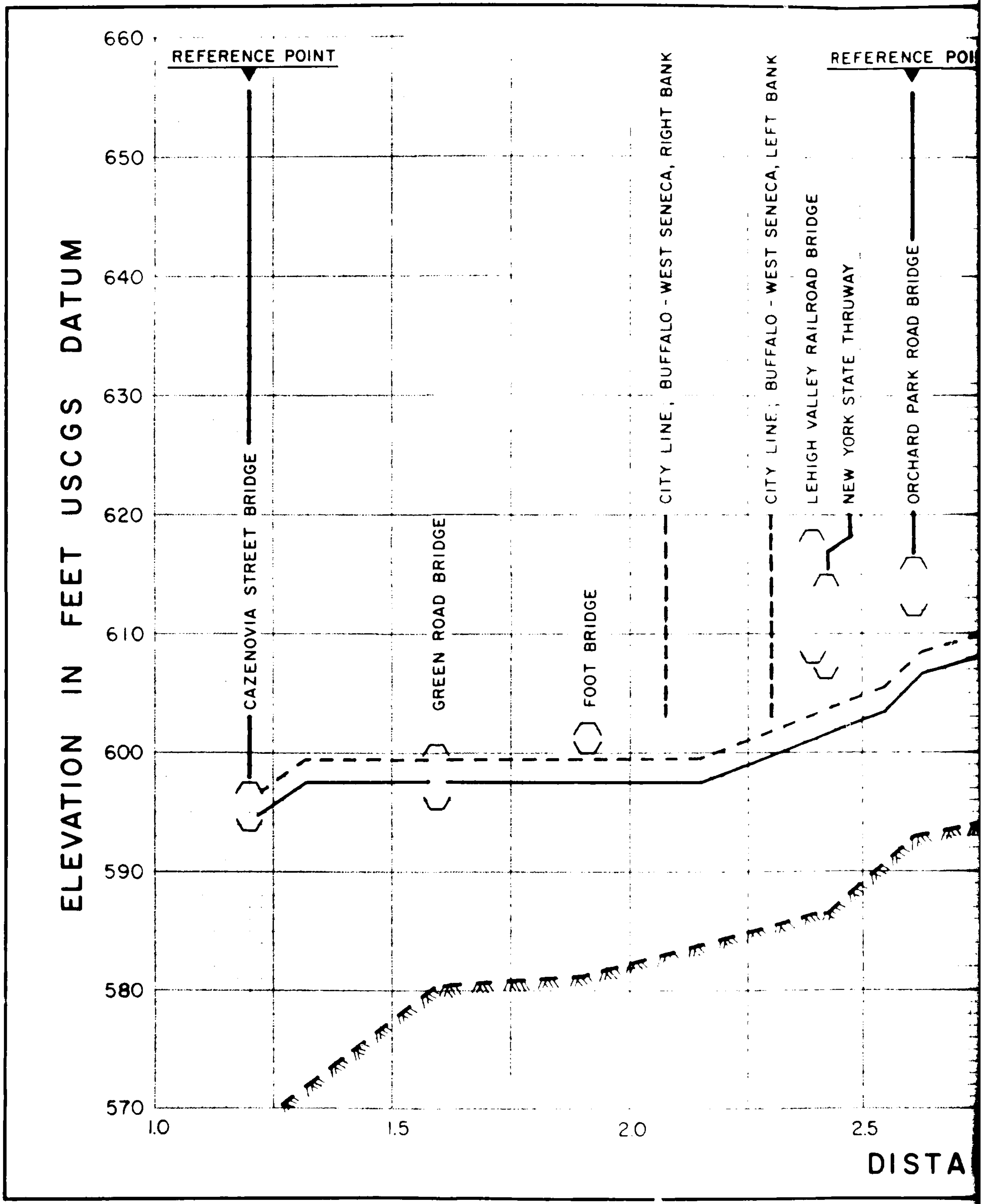


OVIA CREEK, NEW YORK

LOODED AREAS
ILE 4.1 TO 6.2

Y ENGINEER DISTRICT, BUFFALO



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REFERENCE POI
CAZENOVIA STREET BRIDGE
GREEN ROAD BRIDGE
FOOT BRIDGE
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CITY LINE, BUFFALO - WEST SENECA, LEFT BANK
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ORCHARD PARK ROAD BRIDGE
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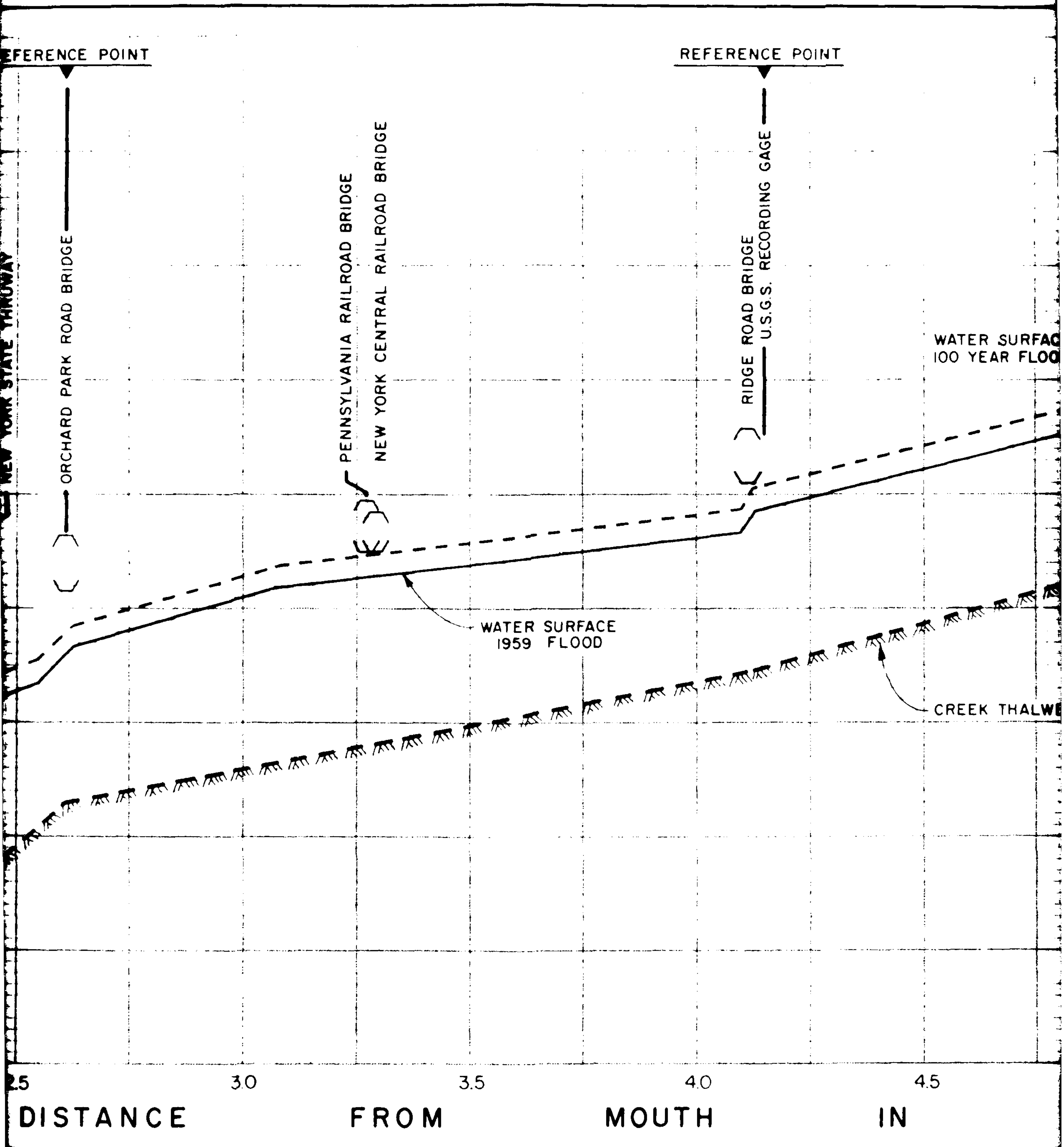

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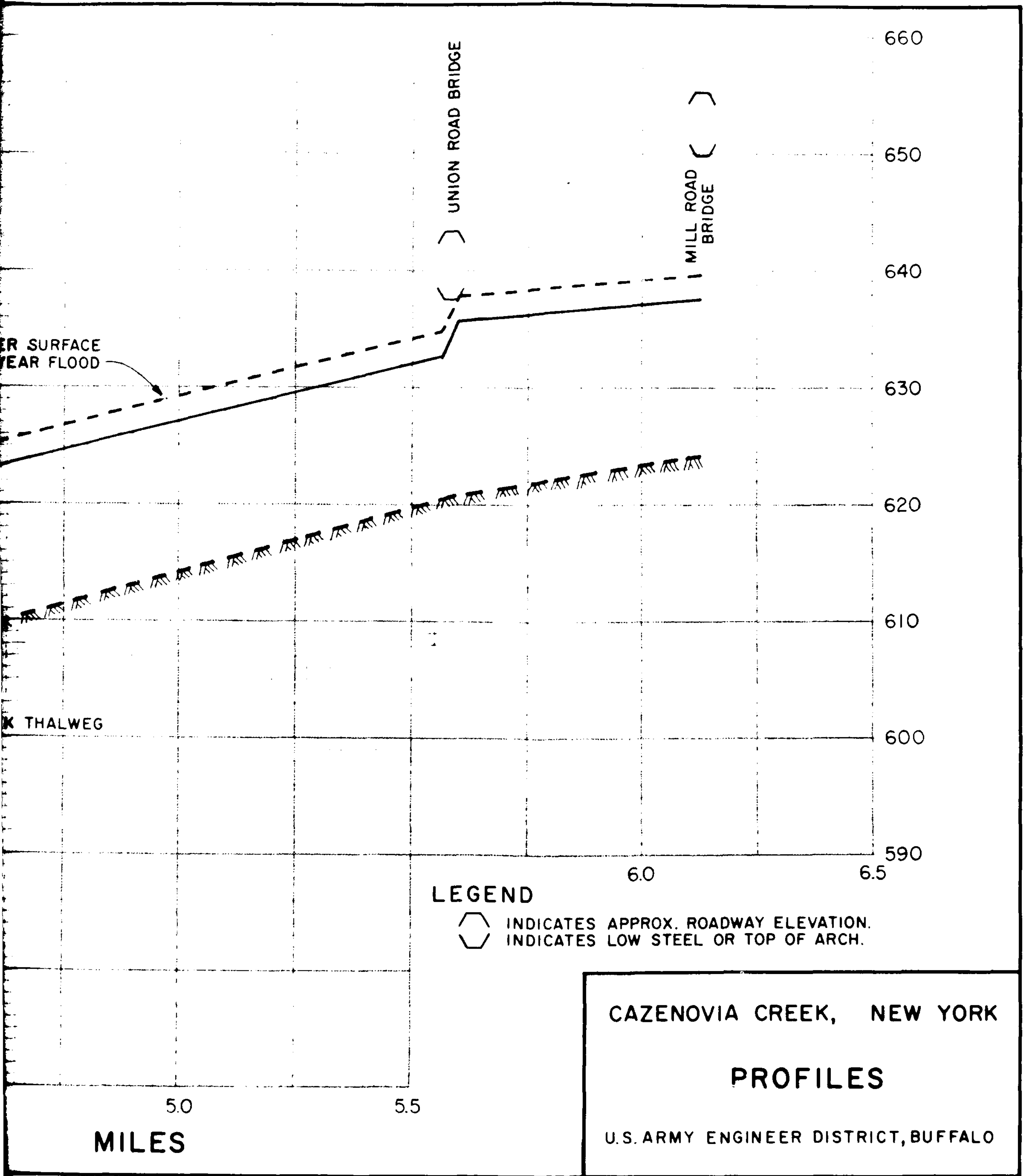

CAZENOVIA CREEK, NEW YORK

PROFILES

U.S. ARMY ENGINEER DISTRICT, BUFFALO

FLOOD PLAIN INFORMATION

STATE OF NEW YORK

ATTACHMENT

FLOOD PLAIN INFORMATION

STATE OF NEW YORK

ATTACHMENT

GENERAL DISCUSSION OF GUIDE LINES FOR FLOOD PLAIN REGULATIONS AND FLOOD PROOFING PRACTICES

1. GENERAL

Regardless of the location of the flood plain or the overall plan of development for the area, the available methods of controlling future flood plain use and of flood proofing existing structures in the flood plain are generally the same. The information in this attachment contains only general suggestions and the details of the regulatory legislation must be tailored to the plan of development for the flood plain concerned. The profiles and flooded area maps contained in the main report provide the basis for this legislation. Useful advice and assistance may be also obtained from those localities where ordinances based on flood plain information studies have already been adopted.

2. METHODS FOR ESTABLISHING FLOOD PLAIN USE

Several sources of information on the problems and preparation of flood plain regulation legislation are included in the bibliographies on Development of Flood Plain Regulations and Planning References which follow this attachment. Several methods of regulating development in flood plains are contained in these references. Some of the controls for the use of the flood plain are discussed in the following paragraphs:

a. Floodway and Restrictive Zones

(1) In order to maintain the necessary floodway for the selected flood, it is essential that encroachment lines or limits are established. These are two definitely located lines, one on each side of the river. Between these lines, no construction or filling should be permitted which will cause an impedance to flow. Final choice of the magnitude of the selected regulatory flood, which in turn will determine the allowable types of development in the affected areas, is a matter for local decision, since in the final analysis it is determined by consideration of their

land usage needs. Since the size of the regulatory flood will be decided upon by local interests after receipt of this report, it is not practical to suggest encroachment limits at this time. However, the Corps of Engineers will provide technical assistance upon request to compare the effects of various widths of floodway on the profile of the flood which is selected by local authorities as the basis for the regulation of the flood plain.

(2) In addition to establishing floodway limits, it is imperative that adequate criteria be set up to regulate vertical and horizontal clear openings and minimum low steel elevations for bridges crossing the flood plain. Bridge piers in the stream channel should be avoided if possible. If the span length requires that piers be used, they should be streamlined and placed parallel to the flow of water. On many creeks, alinement of the bridge crossing to provide for effective passage of ice is also an important consideration The most economical means of crossing a stream is the use of earth embankments with a small bridge or culvert. Unfortunately, this type of structure is the least desirable from a flood damage point of view. If it is kept at a low elevation, it is frequently overtopped and then fails to serve its intended purpose. If the roadway and embankment are kept high, the structure will act as a dam and increase flood stages upstream if the waterway opening is not adequate. The waterway opening should not only be sufficient in area but the area must be available at an elevation which will carry flood flows at a level which does not cause damage. It is sometimes necessary to carry the roadway on a series of piers or bents in order to provide sufficient waterway for flood flows.

(3) Channel bottom profiles should also be well defined. Restrictions should be developed for construction in the channel so that future sewers, utility lines or bridge pier foundations will not interfere with flood flows, suffer damage by floods, or cause expensive modifications if channel improvement is undertaken at a later date. Low dams on the stream, which provide little or no storage and are no longer in use, should be removed in order to reduce the water surface in the immediate area. When a dam is allowed to remain in place the shoal area which forms at the upstream end of the pool should be removed periodically and in order that ice floes and debris are not easily grounded. Sewer crossings should be made beneath the bottom of the stream in order to keep the channel free of unnecessary obstructions.

(4) Other factors adversely affecting flood occurrences are extensive earth or refuse fills within the flood plain and sharp bends in the river channel. Moderate filling within the restrictive zone should have little effect on upstream water surface elevations unless it occurs at an already constricted section. Flood plain regulations may permit a limited amount of filling in the restrictive zones in order that proposed structures may be built above the regulatory elevations. On the other hand extensive filling in these areas will result in a reduction of valley storage capacity which may produce higher peak discharges downstream or cause increased stages upstream through the loss in discharge capacity. Floodway limits or encroachment lines should be established to control filling within the flood plain area in order that the filling will not cause a serious increase in water surface elevations during an occurrence of the selected flood. Sharp bends in the river channel are a form of restriction to flow. As such, they tend to raise upstream stages as well as provide potential trouble spots for the occurrence of ice jams. Any man-made modifications to the flood plain, which tend to increase the sharpness of these bends or restrict the channel, should be avoided. It is sometimes possible to modify the bend with a local channel improvement which would reduce water surface elevations and ice jam occurrences in the immediate area.

b. Zoning - Zoning is a legal tool used by cities, villages and towns to control and direct the use and development of land and property within their jurisdiction. A listing of localities which have adopted zoning ordinances which were based on flood plain information studies is given in the bibliography at the end of this attachment. Correspondence with the local governments concerned may provide useful information on the enactment and enforcement of effective ordinances.

(1) Zoning ordinances should be the result of a comprehensive planning program for the entire area with the purpose of guiding its growth. The State of New York enabling statute which permits zoning is contained in Section 263 of the Town Law. If possible, a double zoning technique is often desirable. In preparing a master land use plan, all areas should be zoned for their most appropriate use. This would be the pattern of development that planners and local officials envision for the locality. Then, because of the flood problem, flood zone restrictions for the appropriate area could be superimposed on the regular zoning map and provisions written into the ordinance specifying the kind of improvement necessary to have these restrictions removed: for example, channel improvement or levees to be constructed

by the developer, filling to a specified minimum elevation, prohibition of basement construction, specified flood proofing, etc.

(2) With respect to the high flood risk areas adjacent to the floodway, consideration should be given to retaining land for open use, such as agriculture, parks and athletic fields. Care must be taken that, as parks are developed, structures of higher damage potential are not placed at an elevation where they will be affected by floods. An illustration of flood plain zoning is shown on exhibit 1.

c. Building Codes - Building codes can be utilized alone or in combination with flood plain zoning. Since it is not always practical to prevent the location of all buildings in all areas subject to flooding, building codes can be used to minimize structural and consequential damages resulting from flood velocities and inundation to those buildings which must be built within the flood area. Building codes can also be used to reduce damage from floods greater than the flood selected for flood plain reference. Some of the methods adaptable for inclusion in building codes are:

(1) Prevent flotation of buildings from their foundations by specifying anchorage.

(2) Establish basement elevations or minimum first floor elevations consistent with past flood occurrences or the selected flood.

(3) Prohibit basements in those areas subject to very shallow, infrequent flooding where moderate filling and slab construction would prevent virtually all damage.

(4) Require reinforcement to withstand water pressure or high velocity flow and prohibit the use of materials which deteriorate rapidly in water.

(5) Prohibit equipment that might be hazardous to life if submerged. This includes chemical storage, boilers or electrical equipment.

d. Subdivision Regulations - Subdivision regulations can often serve as a supplement to zoning. Regulations may specify the lot size, elevation of land, degree of freedom from flooding, size of floodways and other points pertinent to the welfare of the community. Areas which may be attractive for subdivision development during dry weather may be subject to inundation during high flows. The flooded area maps in the main report will enable local governments to become aware

of possible trouble areas before subdivision permits are issued.

e. Other Controls - The following approaches to flood plain regulation may be adaptable to special situations or may serve as supplemental measures to an overall regulation program.

(1) Building financing. Very little building is carried on without financing. Government and private financing institutions can control development of the flood plain by denying mortgage guarantees or funds to subdivision or individual builders who wish to build in the flood plain area.

(2) Public purchase. Outright public land purchase of the flood plain is another method of preventing flood plain development. This method is most effective when made part of a recreation or park plan for the area.

(3) Flood insurance. Flood insurance at the present time is practically nonexistent. However, its use in the future with rates accurately indicating flood potential, could serve as a substantial aid in regulating flood plain development.

(4) Warning signs. An inexpensive method which may be used to discourage development is the erection of flood warning signs in the flood plain area or the prominent posting of previous high water levels. These signs carry no enforcement but simply serve to inform prospective buyers that a flood hazard exists. Several signs or stage boards erected on public property at several locations within the town showing the levels of a past flood and the 100-year flood would provide a convenient reference and keep residents aware of the flood possibilities.

3. REDUCTION OF FLOOD LOSSES BY FLOOD PROOFING

Those who are already residing in the flood plain and are subject to flood damage may be particularly interested in the methods of flood proofing the affected structures in order to reduce the possible damage. A recommended reference is "Flood Proofing: An Element in a Flood Damage Reduction Program", by John R. Shaeffer. Some of the possible flood proofing measures are listed below. The first three methods are particularly applicable to residences or businesses which normally suffer only basement flooding. In the underdeveloped areas, some of the methods may be incorporated into building codes, zoning or subdivision regulations in order that structures permitted in the restrictive zones can be better

protected for floods greater than the selected reference flood. Exhibit 2 illustrates some of these flood proofing methods.

a. Seepage Control - This method involves the use of asphalt or quick set hydraulic compounds to seal walls which are subjected to water pressure. This approach is often complemented with sump pits and pumping.

b. Prevention of Sewer Backup - In many areas, not subject to direct overflow, considerable damage occurs from backup of sanitary or combined sewers that are overloaded by high storm water runoff, flooded manholes or high tailwater at the sewer outlets. Various types of automatic and manually operated valves and checks can be installed on house sewers as well as on lateral and trunk sewers to prevent flooding from sewer backup. In the absence of these measures a section of pipe screwed in place over basement drains is a cheap, effective means of coping with this problem. It allows water to rise up in the pipe but prevents overflow up to the limit of the length of pipe. It is recommended that, whenever possible, the storm and sanitary sewers be separate systems to prevent backup through a combined system into residences from overloaded storm sewers.

c. Permanent Closure - In a relatively watertight structure, unnecessary openings may be permanently sealed. If the passage of light is desirable, glass brick or other translucent material having adequate structural strength, should be considered.

d. Protected Openings - Sandbagging of doorways and other necessary openings in structures has been used as a temporary emergency protection for many years. Removable bulkheads or flood gates are often a more efficient means of accomplishing the same purpose. These devices can be bolted against a frame containing a neoprene gasket which provides a watertight seal.

e. Protective Coverings - The rapid development of new types of plastics with various specific properties should be considered in connection with sealing and protecting machines and mechanical equipment from silt and rust damage.

f. Fire Protection - The possibility of fire from electrical short circuiting is a potential hazard during flooding. Power shut-off on a large scale is generally not practical because it usually would affect areas outside the flooded zone. Attention to fuse protection for individual structures could reduce the possibility of fire when power is not disrupted.

g. Elevation - The regulation of the minimum elevation above which future structures must be built has been discussed previously in connection with zoning and subdivision regulations. However, for existing structures in flood risk areas, provisions can be made for raising machinery, furniture or other valuable equipment above flood level. Some property owners have protected household furnishings during past floods by carrying them to higher floors. Heating plants can be permanently suspended from the cellar ceiling. It is possible to raise the first floor of a structure several feet in order to stay above normal flood levels. The basement would still be subject to damage, however, unless it could be protected by other flood proofing methods.

h. Watertight Covers - Storage tanks with contents which are damageable by flood waters should be protected by gaskets and watertight caps. Watertight covers should also be installed on manholes in the flooded areas. This can prevent basement damage from overcharged sewers or pumping stations by the relatively frequent floods although property in the flooded area would still be subject to damage from greater floods.

i. Structural Design - Sometimes specific features can be incorporated into the design or orientation of a new structure so that potential damages are minimized. Concrete pilings have sometimes been beautifully integrated into the architectural design of a structure, while simultaneously raising the structure several feet above the flood plain.

j. Utilities Service - Considerable financial loss can occur when power failures cause disruption of refrigeration or heat. Disruption of gas service has a similar effect. Rerouting of utilities to provide separate service for flood affected areas can only be achieved by the utility companies. However, combining a general knowledge of the flood problem with foresight and good planning may simplify and expedite rerouting procedures when flooding does occur. In specific cases bottled gas has been used to supply heat, and gasoline driven generators have been utilized to supply minimum essential power.

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**Contains flood plain regulations or extracts

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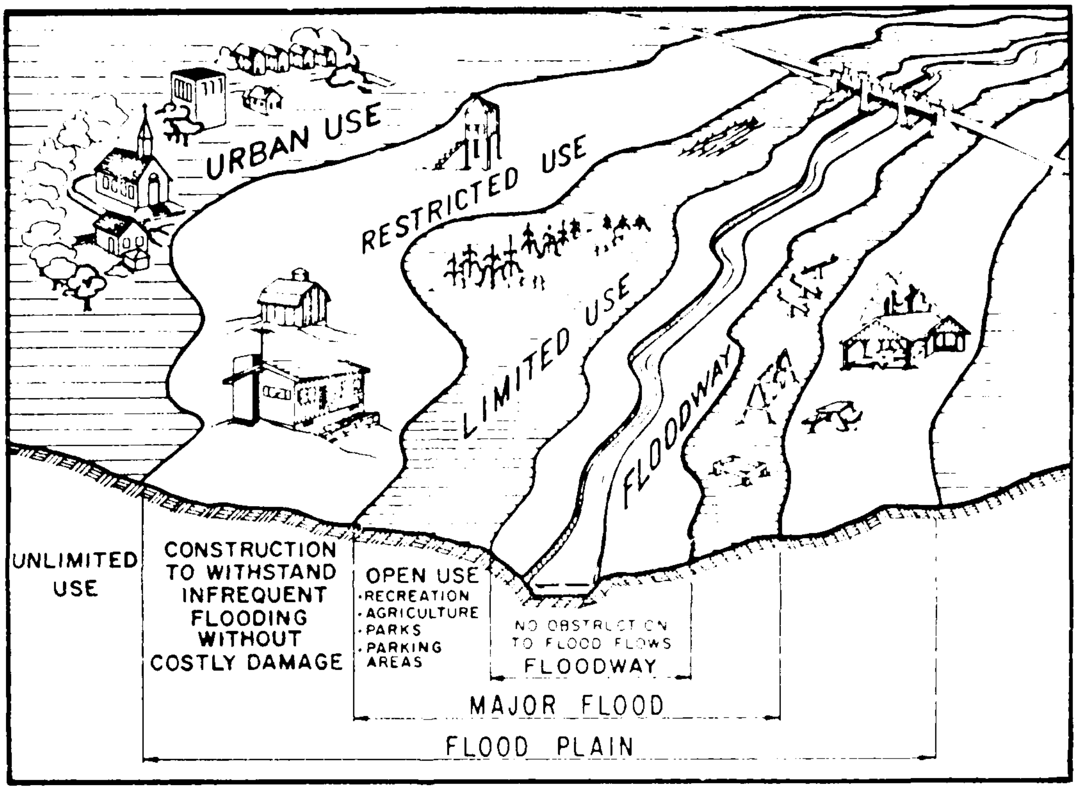
2. Goddard, James E., Flood Proofing and Flood Damage Prevention

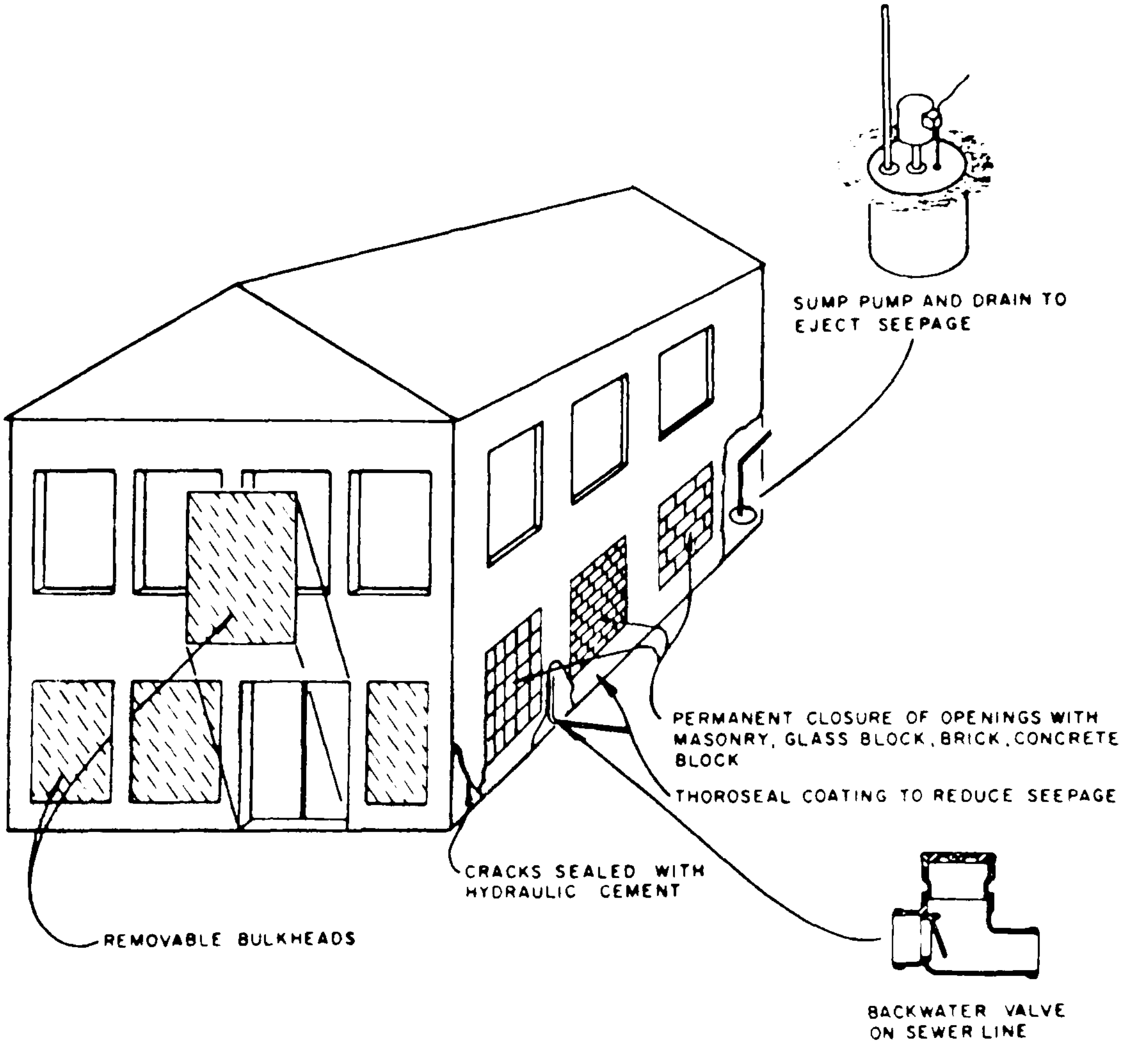
*Contains detailed reading bibliography



NOTE:
THE FLOODWAY IS THAT AREA REQUIRED TO PASS THE SELECTED REGULATORY FLOOD WITHOUT UNDULY RAISING UPSTREAM WATER SURFACE ELEVATIONS.

EXAMPLE OF FLOOD PLAIN ZONING

EXHIBIT I



FLOOD-PROOFED STRUCTURE

NOTE
THIS PLATE REPRODUCED WITH CHANGES FROM "FLOOD PROOFING AN ELEMENT IN A FLOOD REDUCTION PROGRAM," BY JOHN R SHAEFFER.

METHODS OF FLOOD PROOFING A STRUCTURE

EXHIBIT 2

FLOOD PLAIN INFORMATION

CAZENOVIA CREEK, NEW YORK
in the
CITY OF BUFFALO AND THE TOWN OF WEST SENECA

TECHNICAL APPENDIX

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PLATES

TECHNICAL APPENDIX

A1. GENERAL

This appendix has been prepared as a supplement to the Cazenovia Creek Flood Plain Information Report. Its purpose is to provide additional data for the use of those persons concerned with the technical aspects of flood plain planning. The Buffalo District, Corps of Engineers, can provide an explanation or interpretation of the data included, if necessary, or information on how to obtain additional data that may not be included in this report. Such requests should be first coordinated with the New York State Water Resources Commission, Conservation Department, Albany, New York 12226.

A2. CLIMATOLOGY

South Wales Emery Park is the only climatological station located within the Cazenovia Creek basin. The U. S Weather Bureau has, however, collected data for varying lengths of time at 11 additional stations located adjacent to the Cazenovia Creek basin. The periods of record, types and locations of the 12 stations of which 10 are still in operation, are shown in table A1. The locations of these stations relative to each other and to the basin under study are shown on plate A1. The only first-order Weather Bureau Station is located at the Buffalo Airport.

A3. PRECIPITATION

The monthly average precipitation amounts for a representative selection of rainfall stations vary from a minimum of 2.53 inches in February to a maximum of 3.33 inches in May. The highest station average monthly precipitation, 4.34 inches, is that at South Wales Emery Park in September. Average annual precipitation varies from 31.27 inches at Stafford to 40.96 inches at South Wales Emery Park. The average of all stations is 36.92 inches. Annual mean precipitation at each station is shown on plate A1 along with isohyetal lines of equal annual precipitation amounts. The isohyetal pattern shows the area of higher precipitation just east of Lake Erie which includes the Cazenovia Creek basin. Average monthly precipitation for all stations is compared with average monthly precipitation at South Wales Emery Park and the average monthly runoff at the Ebenezer gage on plate A1. During the months of January through April, runoff averages from 80 to 150 percent of the total average monthly precipitation including the water equivalent of snowfall. Annual runoff has averaged about 60 percent of the annual precipitation.

TABLE A1. - Climatological stations in and adjacent to the Cazenovia Creek basin

Station	Period of record	Type	Elevation	Location: Latitude	Location: Longitude
Arcade	1889-1907 1943	NH	1,480	42°32'	78°25'
Batavia	1931-present	CH	900	43°00'	78°11'
Buffalo W.B. Airport	1932-present	CHJ	705	42°56'	78°44'
Derby 2 N.W.	1945-1961	NH	660	42°42'	78°00'
Elma	1942-1960	CH	765	42°51'	78°39'
Gowanda State Hospital (1)	1945-present	CHJ	865	42°29'	78°56'
Linden	1912-present	N	1,120	42°53'	78°10'
South Wales Emery Park(2)	1931-present	NH	1,090	42°43'	78°36'
Stafford	1931-present	NH	915	42°59'	78°05'
Wales	1948-present	C	1,150	42°44'	78°31'
Warsaw 5 S.W.	1952-present	N	1,715	42°41'	78°12'
Wiscoy	1940-present	NH	1,200	42°30'	78°05'

(1) Known as Gowanda prior to May 1951.

(2) Known as South Wales prior to April 1951.

C Recording gage.

N Non-recording gage.

H Snowfall data.

J Supplemental data.

A4. SNOWFALL

The average annual snowfall for all stations is 82.3 inches. Of the monthly means for these stations, the highest is 22.4 inches, occurring in January at Arcade. Average annual snowfall for nearby stations is shown on plate A2 with lines of equal annual snowfall developed for the area. Average monthly snowfalls for South Wales Emery Park and the area stations are shown on the graph on plate A2. The water equivalent of the snow is included in the precipitation figures of plate A1. The snowfall pattern shows an area of higher snowfall running northeast from Lake Erie as moisture laden air is carried from Lake Erie by prevailing southwest winds.

A5. TEMPERATURE

The average annual temperature for all stations is 46.9 degrees Fahrenheit. July is the warmest month and January is the coldest month with average temperatures of 69.2 and 24.2 degrees Fahrenheit, respectively.

A6. NOTABLE STORMS

The most notable of recent storms that produced high water were the June 1937, February 1939, March 1942, March 1955, March 1956, January 1959, and January 1962 storms. Earlier floods, documented in previous reports by various agencies, occurred in February 1902, February and March 1904, and January 1929. Known rainfall and discharges for the more recent storms are shown in tables A2 and A3, respectively.

TABLE A2. - Comparative rainfall-runoff data (approximated) for recent notable storms over Cazenovia Creek

Storm	Average precipitation (inches)	Runoff at gage (inches)
March 1955	2.4	2.0
March 1956	2.1 (1)	2.1
January 1959	1.8 (2)	1.7

(1) Some snow melt occurred in upper part of basin.

(2) Approximately 7 inches of snow melted over the basin.

TABLE A3. - Notable flood discharges, in cfs at the U.S. Geological Survey gage at Ridge Road

Flood	June 1937	March 1942	March 1955	March 1956	January 1959
Discharge	11,100 (1)	11,200 (2)	13,500 (2)	13,000 (2)	12,600 (2)
cfs/sq.mi.	83	84	101	97	94

(1) Estimated by Corps of Engineers.

(2) Published by United States Geological Survey

A7. RAINFALL INTENSITY

The intensity-duration curve on plate A3 indicates how frequently storms of a specific average rainfall intensity, lasting for a specific length of time, can be expected to occur at the Buffalo Weather Bureau Airport station. This curve is representative of a rainfall that may occur at any point within the Cazenovia Creek basin. The basic data for plate A3 was derived from U. S. Weather Bureau Technical Paper No. 40, "Rainfall Frequency Atlas of the United States. The January 1959 rainfall had an average intensity at the Buffalo W.B. Airport station of 0.11-inch per hour for a period of 11 hours. From plate A3, this average intensity for a 11-hour period would have a frequency of once in about 1.5 years. Approximately 7 inches of snow on frozen ground added to the runoff from the storm rainfall.

A8. During the March 1955 storm, the station at Wales developed an average intensity of about 0.31-inch per hour for a period of 7 hours, which has a frequency of once in about 10 years.

A9. The maximum 24-hour rainfall recorded at Buffalo was 4.28 inches on 28-29 August 1893. On 7 August 1963, the official U. S. Weather Bureau station at the Buffalo Airport recorded 3.88 inches in 24 hours, most of which fell in about 5 hours. A precipitation recorder at the Buffalo Sewer Authority in South Buffalo recorded 4.88 inches for this same period. This storm established new records for one-hour and two-hour durations during the month of August. Plate A3 indicates that the rainfall of 1.74 inches which occurred in one hour has a frequency of once in about 20 years. The 2.58 inches which fell in two hours has a frequency of about once in 50 years. The 5-hour rainfall of 3.69 inches has a frequency of about once in 100 years. Plate A3 may be especially useful to those designing and approving the design of culverts and other small drainage structures which may be constructed within the basin.

A10. STREAM FLOW RECORDS

The United States Geological Survey has published records of stream flow at the Ridge Road gage site in Ebenezer since the gage was established in June 1940, except for six months in 1955 during the construction of a new highway bridge. The station records stages resulting from runoff from the 134 square miles of watershed upstream of that point. The total drainage area of the watershed is 138 square miles so that this gage site measures almost the total creek flow. The records from this gage were used in developing the discharge-frequency and stage-frequency relationships as described in paragraphs A14 through A19. Since this recording gage on Cazenovia Creek was not installed until June 1940 no record of the June 1937 flood was obtained. A comparison of approximate rainfall and runoff for recent storms is shown in table A2. Recent notable flood discharges are compared in table A3. The maximum discharge recorded at the Ebenezer gage site is 13,500 cfs on 1 March 1955. Discharge per square mile was approximately 101 cfs for this occurrence. Daily mean discharges and annual peak discharges are published annually by the United States Department of the Interior-Geological Survey in Surface Water Records of New York. Copies of that report may be obtained from District Chief, Water Resources Division, U. S. Geological Survey, P. O. Box 948, Federal Building, Albany, New York 12201. Staff gages have been established by the Erie County Department of Public Works at Orchard Park Road and Cazenovia Street. The gages are located on plates 2 and 3, and are described in table A4.

TABLE A4. - Staff and recording gages

Location	Operating Agency	Type	Drainage area sq. mi.	Elevation of gage zero U.S.C. & G.S. datum
Cazenovia Street-upstream retaining wall, right bank	Erie Co. D.P.W.	Staff	137	580.30
Cazenovia Street-upstream retaining wall, left bank	Erie Co. D.P.W.	Staff	137	581.92
Orchard Park Road - down stream left abutment	Erie Co. D.P.W.	Staff	136	593.64
Ebenezer - upstream side of Ridge Road, right bank	U.S.G.S.	Recorder in standard gage house	134	604.86

A11. RATING CURVES

The stage-discharge relationship for the gage site shown on plate A6 was developed from the discharge measurements made at the site by the United States Geological Survey. The rating curve is well defined by discharge measurements to 7,700 cfs and was extended through logarithmic plotting to 13,500 cfs on the basis of the March 1955 flood. All of the references to flood discharges in this report were based on this original rating.

A12. Because of the sharp break in the channel profile at Cazenovia Street, channel discharges go into super-critical flow making backwater computations impossible to compute. Therefore the rating curve for reference point 1 at Cazenovia Street was developed by computing critical depths from the generalized expression $Q^2/g = a^3/T$, where:

Q = discharge in the channel in cubic feet per second.

g = gravitational acceleration of 32.2 feet per second.

a = The cross sectional area of the waterway in square feet.

T = The top width of the channel in feet at the water surface.

From this formula the discharge can be solved at any critical depth. The data for this formula is based on channel conditions after improvements by the City of Buffalo.

A13. A curve relating stage to discharge for open water conditions was also developed for the reference point at Orchard Park Road bridge and is shown on plate A6. A series of back water computations were made, using Manning's formula, to determine the water surface elevation at the reference point for a number of selected discharges. Manning's formula for open channel flow is $Q = \frac{1.486}{n} AR^{2/3}S^{1/2}$ where:

Q = discharge in cubic feet per second

n = a friction constant which is an index of the relative resistance to flow of the surface over which the water flows

A = cross sectional area of the waterway in square feet at the water surface

R = hydraulic radius - the ratio of the cross sectional area of the waterway at the water surface to the perimeter of the channel or overbank which comes in contact with the water

S = slope of the water surface in foot per foot.

Starting backwater elevations were selected from a critical depth curve derived at Cazenovia Street bridge.

A14. FREQUENCY CURVES

Records of annual peak discharge from the United States Geological Survey gage at reference point 3 are available for 24 years. During winter and spring runoff conditions the stage and discharge relationship is usually affected bt ice jams making it difficult to determine a discharge for a particular flood.

A15. A method described in "Statistical Methods in Hydrology", by Leo R. Beard was used to develop the (statistical) discharge-frequency curve for the gage at Ebenzer, using the peak discharges for the 24-year period of record. This frequency curve was assumed to be applicable for all reaches since there is only a 3 square mile difference in drainage area between reference point 1 and reference point 3. This frequency curve is shown on plate A4.

A16. Due to the frequent occurrence of ice jams, stage-frequency curves were also developed for the three reference points and were considered to be more representative of the damage-frequency relationship. A stage-frequency curve for each of the reference points is shown on plate A4.

A17. Annual maximum stages at the Cazenovia Street bridge, reference point 1, were obtained from Corps of Engineers high water marks, the City of Buffalo's daily notes and the rating curve using annual maximum discharges. The stages, for a total record of 24 years, were arrayed in descending order and assigned a plotting position as described in "Statistical Methods in Hydrology", by Leo R. Beard. The resulting curve gave an exceedence frequency of approximately four percent for the January 1959 flood stage, which is the maximum flood of record at reference point 1.

A18. Only the three highest stages in the last 20 years were known at Orchard Park Road, reference point 2. The stages for the remaining events were not known; however, they were known to be lower than the three highest stages. These high stages, due to ice jams, were plotted using the plotting method of Beard. Also, an ice-free, stage-frequency curve, developed from the rating curve at Orchard Park Road and the discharge-frequency curve, was plotted by the same method. An ice stage-frequency curve was then drawn through the three highest peaks using the ice-free, stage-frequency curve as a guide. This stage-frequency curve indicates that the stage of the flood of March 1955, which has the maximum discharge of record at reference point 2, has an exceedence frequency of five percent.

A19. At the gage site in Ebenezer, reference point 3, 24 maximum stages at the recording gage for the period of record were arranged and plotted as suggested by Beard. This produced a stage-frequency curve indicating that the March 1955 flood, which is the maximum known flood of record at reference point 3, has an exceedence frequency of four percent.

A20. A discharge-drainage area relationship has been developed for the Cazenovia basin so that a frequency curve can be estimated for a location on the stream other than at the gage site.

A21. Cayuga Creek, Buffalo Creek and Cazenovia Creek are all of the same watershed. These creeks and Cattaraugus Creek have similar basin topography and are subject to the same storms. A discharge-drainage area relationship was developed using data from the gage at Lancaster on Cayuga Creek, at Gardenville on Buffalo Creek, near Ebenezer on Cazenovia Creek, and at Gowanda on Cattaraugus Creek. The relationship was developed by plotting the mean annual discharge (two-year frequency) for the period of record vs. drainage area on log-log paper and determining the equation for the line of best fit through the points. The resulting equation is $Qm = 196A^{0.736}$ where "Qm" is the mean annual flood discharge in cfs (50% exceedence) and "A" is area expressed in square miles. This generalized curve is shown on plate A5. The information on plate A5 may be used to develop a discharge-frequency curve for any point in the basin where the drainage area is known. For example, to compute the discharge-frequency relationship for the Cazenovia basin with 50 square miles of drainage upstream of that point, the procedure outlined on plate A5 should be followed. The three computed discharge values of Qm, $Q_{15.9\%}$ and $Q_{84.1\%}$ should then be plotted on log-probability paper and connected by a single line. This line represents the discharge-frequency relationship for the given drainage area. The vertical dashed lines on the discharge-frequency on plate A4 will serve as a guide in plotting Qm, $Q_{15.9\%}$ and $Q_{84.1\%}$.

A22. BRIDGES

Table A5 contains data on bridges over the Cazenovia Creek which are pertinent to flood carrying capacities. Visual observation during floods, coupled with information in the table will give a guide to the determination of the relative construction of various bridges along the creek within the study area.

A23. BENCH MARKS

In determining the elevations of the high water marks through the study area, numerous bench marks were established for vertical control. Table A6 is a listing of the location and description of these bench marks. The bench marks are also located, approximately, on plates 2 and 3, of the main report. The list is presented as an aid to local interests in establishing staff or crest gages, setting minimum elevations for future development or establishing other elevations necessary to flood plain planning. All elevations in this report are referred to U.S. Coast and Geodetic Survey datum. The correction factors between U.S.C. & G.S. datum and other datum planes used in the area are given in table A7. The bench marks listed in table A6 should be suitably marked and preserved.

TABLE A5 - Bridge data

Name of bridge	Creek mile	Description	Clear height feet	Total clear width feet	Skew angle (1) degrees	Low steel elevation (2) feet	Approximate roadway elevation (2) feet	Approximate waterway area to low steel elevation (7) square feet
Cazenovia Street	1.20	Single span-through steel girder	25	110	15	593.44	597.56	2360
Green Road	1.59	Two span-through steel girder	15	112	0	595.20	600.80	1670
Foot Bridge	1.91	Suspension	18	155	0	600.05	602.35	2230(6)
Lehigh Valley Railroad	2.39	Three span plate girder	20	296 (3) 198	10	607.59	618.84	4450
New York State Thruway	2.42	Four span-continuous steel beam	19	335 (5) 212	10	606.25	615.05	4390
Orchard Park Road	2.61	Single span steel truss	19	153	10	611.50	616.32	2940
Pennsylvania Railroad	3.27	Two span plate girder	14	187	0	614.98	619.60	2480
New York Central Railroad	3.29	Two span plate girder	16	158	0	[illegible]	618.53	2530
Ridge Road	4.11	Two span-deck girder	16	150	20	621.03	625.91	2400
Union Road	[illegible]	Two span concrete arch	17(4)	193	20	637.50(4)	643.19	2290
Mill Road	6.13	Two span concrete arch	25(4)	110	15	649.85(4)	655.15	2260

1) The angle of skew is measured between the longitudinal axis of the bridge and a perpendicular to the center line of the channel.
2) U.S.C. & G.S. datum
3) Left end section only used during high stages
4) Top of arch
(5) End sections only used during high stages
(6) Approximate waterway area to top of bank
(7) This area must be multiplied by the cosine of the skew angle to obtain the effective area of bridge, parallel to the flow of water.

CAZENOVIA CREEK, NEW YORK

TABLE A6 - Bench mark descriptions

Bench mark designation + approximate creek mile	Elevation feet on U.S.C. & G.S. datum	Description
A 1.20	596.79	A chiseled cross on top of concrete retaining wall on left bank downstream side of Cazenovia Street bridge over Cazenovia Creek.
B 1.46	598.11	A chiseled cross on top of southerly bolt of fire hydrant at the corner of Abbott Road and Red Jacket Parkway.
C 1.59	597.85	At Green Road bridge over Cazenovia Creek in Cazenovia Park, a chiseled square on the downstream corner of the base for the square pillar on the left bank downstream wing wall.
D 1.76	598.24	On the northwest corner of Beyer and Willink Streets, on top of the letter "n" in the word "open" on the fire hydrant.
E 1.82	604.10	A chiseled cross on top of southerly bolt of fire hydrant, on the south side of Potters Road, 50 feet east of Woodside Avenue, in front of residence number 203.
F 1.91	597.50	A chiseled cross on top northwest corner of the downstream left bank concrete cable anchor for the suspension foot bridge in Cazenovia Park over Cazenovia Creek.
G 1.99	610.69	A chiseled square located on the southeast corner of a 3-foot high by 2-foot square concrete block, on the north side of Potters Road, 50 feet west of Br[illegible]

TABLE A6 - Bench mark descriptions (Cont'd)

Bench mark designation + approximate creek mile	Elevation feet on U.S.C.&G.S. datum	Description
H 2.39	605.52	A chiseled square on top of the left bank concrete bridge seat, 2.07 feet below the upstream side steel beam for the Lehigh Valley Railroad bridge over Cazenovia Creek.
I 2.61	616.63	At Orchard Park Road bridge over Cazenovia Creek. A chiseled cross on top of left bank downstream abutment.
J 3.27	613.83	At Pennsylvania Railroad bridge over Cazenovia Creek. A chiseled square on top of the bridge seat on the left bank downstream side.
K 3.29	617.23	At the New York Central Railroad bridge over Cazenovia Creek. A chiseled square on top of the left bank upstream abutment.
L 4.11	625.81	At the Ridge Road bridge over Cazenovia Creek. A standard U.S.G.S. bronze reference mark set in the top of the downstream right bank bridge abutment.
M 4.11	625.70	At the Ridge Road bridge over Cazenovia Creek. A standard U.S.G.S. bronze reference mark set in the top of the upstream right bank bridge abutment.
N 5.58	642.03	At the Union Road bridge over Cazenovia Creek. A chiseled square on the top of concrete at the base of the steel railing on the downstream side, 80 feet from the north end and over the center of the north arch of bridge.
O 6.13	650.05	At Mill Road bridge over Cazenovia Creek. A chiseled cross on top of right bank downstream abutment at junction of wing wall and abutment.

TABLE A7 - Conversion factors between United States Coast and Geodetic Survey datum and other area elevation data.

To obtain U. S. Coast and Geodetic Survey Datum

Datum	Conversion factor
U. S. Lake Survey datum (1935)	- 0.56 feet
International Great Lakes datum (1955)	+ 1.29 feet
City of Buffalo datum	+ 575.45 feet

NOTE: Although these conversion factors may vary slightly in different localities, they should give satisfactory results for flood plain regulation purposes.

A24. HIGH WATER MARKS

A tabulation of the high water marks obtained in the study area for the January 1959, 1962 and 1964 floods are given in table 18 of this appendix. The approximate locations of the high water marks are shown on plates 2 and 3. The 1959 high water marks were used to develop the 1959 flood profile, shown on plate 4. It will be noted that the profile, as drawn, does not pass exactly through all of the high water marks. All high water mark elevations contain some inaccuracies in reporting, due to wave action, velocity head, lack of a suitable reference, etc., and a profile must be fitted through the available points considering river slope, channel sizes and overbank flow areas. The profiles furnished provide sufficient data for use as references for flood plain regulations. The individual high water marks are furnished to provide a series of known elevations from which future flood elevations can be measured. The new flood elevations can be determined by simply measuring up or down from the known high water mark. The elevations from the high water marks can also be transferred to any nearby property to determine the extent and depth of inundation for that flood. The elevations of the high water marks are given to the nearest hundredth of a foot. This amount of precision is not obtained from the original high water descriptions but is the actual elevation of the shiner, paint mark, etc., which marks its location. This permits these high water marks to be used as additional bench marks in subsequent flood plain survey work.

A25. USE OF THE DATA

The data on climatology and notable storms provide general information on the causes and results of past floods. The rating curves and frequency data give an indication of the return interval of various flood occurrences and thereby provide a basis for selection of the regulatory flood. The flood profiles and maps of inundated areas can be used to establish flood plain regulations throughout the study area along Cazenovia Creek. The high water mark elevations and bench marks can be used to determine possible flood elevations at any property or prospective development within the study area.

A26. AUTHORIZATION

This flood plain information report has been prepared under the authority granted in Section 206, Public Law 86-645, as amended, (Flood Control Act of 1960). The test of Section 206 stated "(a) That, in recognition of the increasing use and development of the flood plains of the rivers of the United States and of the need for information on flood hazards to serve as a guide to such development, and as a basis for avoiding future flood hazards by regulation of use by states

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FLOOD PLAIN INFORMATION, CAZENOVIA CREEK, NEW YORK IN THE CITY --ETC(U)
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TABLE AC. High water mark elevations

No.	Creek: mile	Location	Flood	Description	Reliability	Elevation U.S.C.&G.S.
1	1.2	74 Cazenovia Street Buffalo, N.Y.	Jan 59	Water was up to yellow shiner on 40" diameter tree, 3.25' above the sidewalk in front of #74 Cazenovia Street.	Good	594.92
2	1.2	4 Cazenovia Street Buffalo, N.Y.	Jan 59	Water was up to yellow shiner on 18" diameter tree 2.90' above the ground between the two side entrances of #4 Cazenovia Street.	Fair	594.23
	1.5	Cazenovia Park Garage Buffalo, N.Y.	Jan 59	Water was up to metal shiner, 5.85' above basement garage floor.	Good	597.85
			Jan 62	Water was 2.70' below shiner.	Good	595.15
4	1.8	210 Potters Road Buffalo, N.Y.	Jan 59	Water was up to metal shiner, 1.5' above the basement window sill on right side of rear house on lot.	Good	596.80
			Jan 62	Water was 0.70' above shiner.	Good	597.50
5	1.7	20 Beyer Street Buffalo, N.Y.	Jan 59 & Jan 62	Water was up to yellow shiner facing the sidewalk on pole NL 18, 1.10' above ground, between 18 & 20 Beyer Street.	Fair	597.87

TABLE A8. High water mark elevations (Cont'd)

No.	Creek: mile	Location	Flood	Description	Reliability	Elevation U.S.C.&G.S.
6	1.9	Northwest corner of Beyer & Willink Streets Buffalo, N.Y.	Jan 59	Water was 1.62' below top of letter "n" in the word "open" on the fire hydrant on the northwest corner of Beyer & Willink Sts.	Fair	596.62
7	2.1	60 & 61 Wichita Road Buffalo, N.Y.	Jan 59 &	Water was up to yellow shiner, facing the street on pole 607/7 0.20' above the ground	Poor	597.01
			Jan 62	in front of #61 Wichita Road.	Fair	597.01
8	2.5	46 Fairfax Drive West Seneca, N.Y.	Jan 59	Water was up to yellow shiner on west side of pole NYT 4, 1.30' above ground in front of #46 Fairfax Drive.	Poor	603.42
			Jan 62	Water was 0.1' below the shiner.	Fair	603.32
			Feb 65	Water was 3.25' below the shiner, at the rear of #46 Fairfax Drive.	Fair	600.17
9	2.8	154 Orchard Park Road West Seneca, N.Y.	Mar 55	Water was up to yellow shiner on pole V, NYSE&G 14 NYT 13, 0.60' above the ground in front of #154 Orchard Park Road.	Fair	607.52
			Jan 59	Water was 0.90' below the shiner.	Good	606.62
10	3.0	276 Orchard Park Road West Seneca, N.Y.	Jan 59	Water was up to yellow shiner on pole at the driveway of #276 Orchard Park Road 1.4' above the ground.	Fair	611.98

TABLE A8. High water mark elevations (Cont'd)

No	Creek mile	Location	Flood	Description	Reliability	Elevation U.S.C.&G.S.
11	[illegible].8	W.Seneca Central School Bus Garage 330 Seneca Street West Seneca, N.Y.	Mar 55	Water came up to the first concrete joint from the overhead garage doors, about 20' from the building.	Excellent	617.30
			Jan 59	Water came up to the shoulder of Seneca Street in the low part of the street just downstream from the garage.	Fair	615.00 ±
12	4.0	3435 Seneca Street West Seneca, N.Y.	Mar 55	Water was up to yellow shiner on pole NYSE&G 83-1, NYT 51, 0.70' above ground in front of #3435 Seneca Street.	Good	617.65
13	5.3	5 West Willowdale Drive West Seneca, N.Y.	Feb 65	Water was up to yellow shiner on 18" diameter poplar tree ± 40' south of house on west property line, 2.5' above ground	Good	629.27
			Jan 64	Water was 0.8' below the shiner.	Good	628.47
			Jan 62	Water was 1.6' below the shiner.	Fair	627.67

TABLE A8. High water mark elevations (Cont'd)

No.	Creek mile	Location	Flood	Description	Reliability	Elevation U.S.C.&G.S.
14	5.7	33 Willowdale Drive West Seneca, N.Y.	Jan 59	Water was up to yellow shiner on pole NYP 3 between 25 & 33 Willowdale 2.75' above ground.	Excellent	635.29
			Jan 62	Water was 1.76' below the shiner.	Good	633.53
			Jan 64	Water was 1.00' below the shiner.	Excellent	634.29
			Feb 65	Water was 1.45' below the shiner.	Excellent	633.84
15	6.1	765 Mill Road West Seneca, N.Y.	Feb 65	Water was up to yellow shiner on pole 13 E NYT 3 across from #765 Mill Road.	Good	641.79
			Jan 62	Water was 1.21' below the shiner.	Good	640.58
			Mar 55	Water was 0.71' below the shiner.	Good	641.08

and municipalities, the Secretary of the Army, through the Chief of Engineers, Department of the Army, is hereby authorized to compile and disseminate information on floods and flood damages, including identification of areas subject to inundation by floods of various magnitudes and frequencies, and general criteria for guidance in use of flood plain areas; and to provide engineering advice to local interests for their use in planning to ameliorate the flood hazard: Provided, that the necessary surveys and studies will be made and such information and advice will be provided for specific localities only upon the request of a State or a responsible local governmental agency and upon approval by the Chief of Engineers, (b) The Secretary of the Army is hereby authorized to allot, from any appropriations, hereafter made for flood control, sums not to exceed $2,500,000 in any one fiscal year for the completion and dissemination of such information."

ERIE COUNTY

DEPARTMENT OF PUBLIC WORKS
H. DALE BOSSERT, P. E.—COMMISSIONER

DIVISION OF DRAINAGE AND SANITATION
CHARLES C. SPENCER, P. E. — DEPUTY COMMISSIONER
ROOM 711, 45 CHURCH STREET BUILDING, BUFFALO 2, N. Y.
TELEPHONE TL 6-7190, EXTENSIONS 289 AND 290

November 17, 1961

Col. Leon J. Hamerly, District Engineer
U. S. Army Corps of Engineers
Foot of Bridge Street
Buffalo 7, New York

Dear Colonel Hamerly:

We have had several discussions with representatives of your office concerning flood plain information studies which your office is authorized to make under Section 206 of Public Law 86-645. We feel that basic studies your office is authorized to make under this law would be very helpful to Erie County. We have secured a copy of Bulletin EM 1165-2-111 dated the 31st of March 1961 stating that local agencies may make an application to the District Engineer for flood plain studies and that they should provide certain information. At the suggestion of Mr. McKee in your office we are sending this application through New York State. We were informed today by the Water Resources Board that Mr. Horace Evans of the State Department of Public Works is handling applications of this nature.

The Erie County Drainage Agency was established by the Board of Supervisors under Item 33, Meeting No. 4 of that body on December 27, 1960. It provided that the Drainage Agency should have the powers prescribed in Article 5-c of the County Law and such other powers and duties as the Board of Supervisors may determine necessary to carry into effect the provisions of said article. The membership of the Agency consists of seven (7) persons, at least three (3) of whom shall be duly elected members of the Board of Supervisors, one (1) of whom shall be the Commissioner of Planning, and three (3) of whom shall be citizens of the United States residing in Erie County; all of whom shall be appointed by the County Executive of Erie County, and confirmed by the Board of Supervisors. A copy of Article 5 of the County Law is attached for your information.

In accordance with Section 11-D of EM 1165-2-111 we assure you that your information report will be publicized in the community and area concerned and that copies will be made available for use or inspection by responsible interested parties and individuals.

Zoning and other regulatory, development and planning agencies and public information media, will be provided with the flood plain information for their guidance and appropriate action.

Survey markers, monuments, etc. established in any Federal surveys undertaken for Sec. 206 studies, or in regular surveys in the area concerned, will be preserved and safeguarded.

The Drainage Agency, at their meeting on October 6, 1961, resolved to make an application to your office for flood plain studies on Tonawanda, Ellicott, Cazenovia, Cayuga, Buffalo and Smokes Creeks. Mr. McKee suggested a separate letter on each

#2 - - - - - - NOVEMBER 17, 1961
C. C. SPENCER TO COLONEL HAMERLY
- -

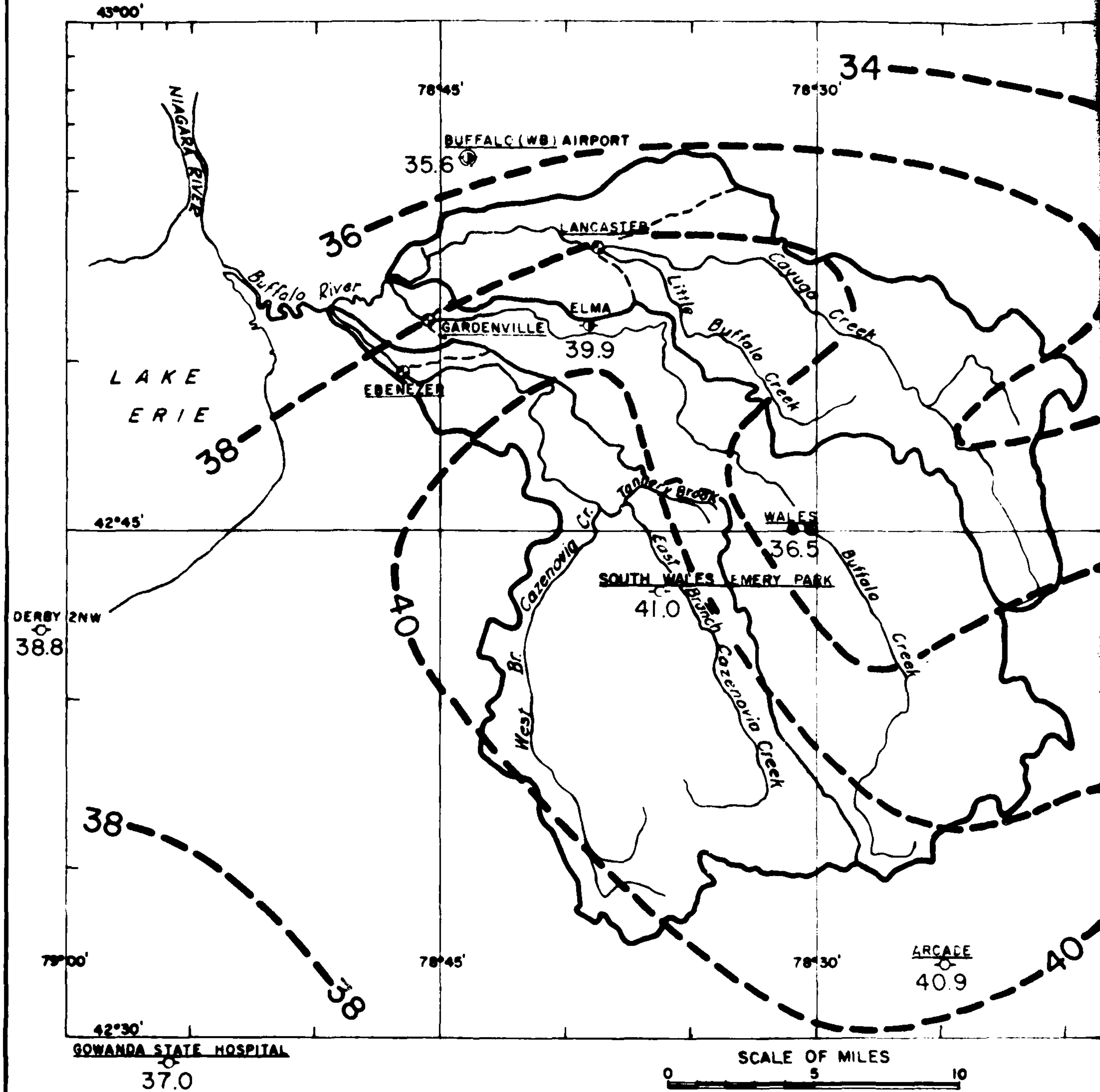
CREEK AND THIS LETTER, THEREFORE, REQUESTS THE STUDIES ON CAZENOVIA CREEK FROM CAZENOVIA STREET IN THE CITY OF BUFFALO TO THE VICINITY OF MILL ROAD IN THE TOWN OF WEST SENECA.

WE WILL BE GLAD TO DISCUSS THIS APPLICATION FURTHER WITH THE STATE OF NEW YORK OR WITH YOUR OFFICE AT ANY TIME.

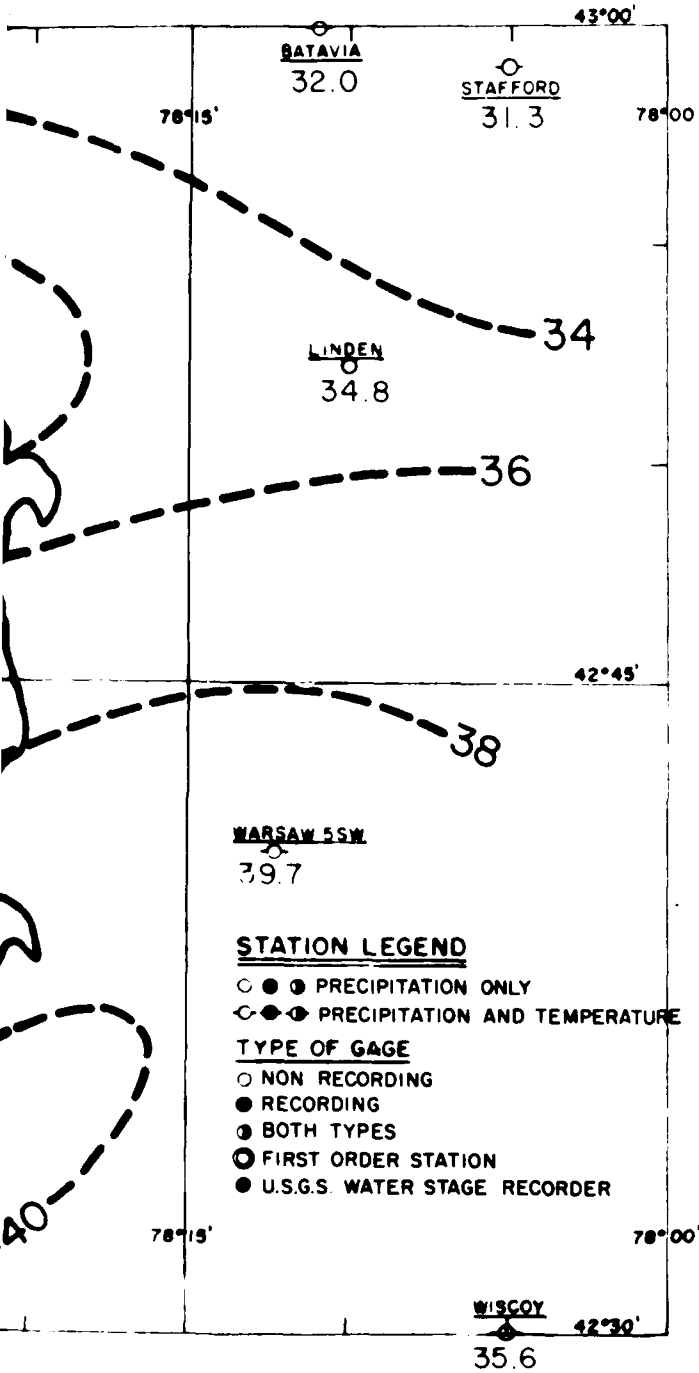
VERY TRULY YOURS,

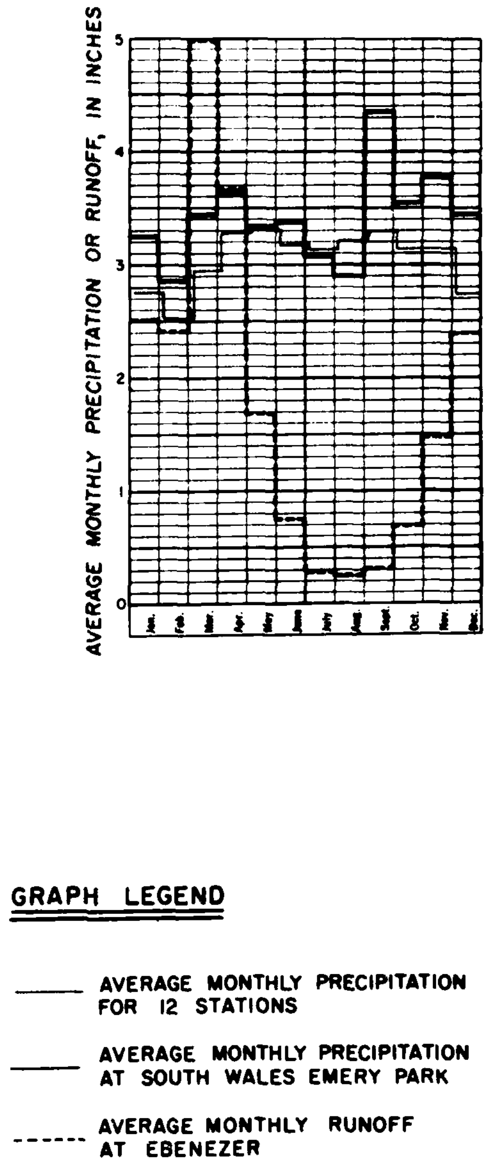
CHARLES C. SPENCER, P. E.,
DEPUTY COMMISSIONER

CCS:LM



AVERAGE ANNUAL PRECIPITATION IN IN



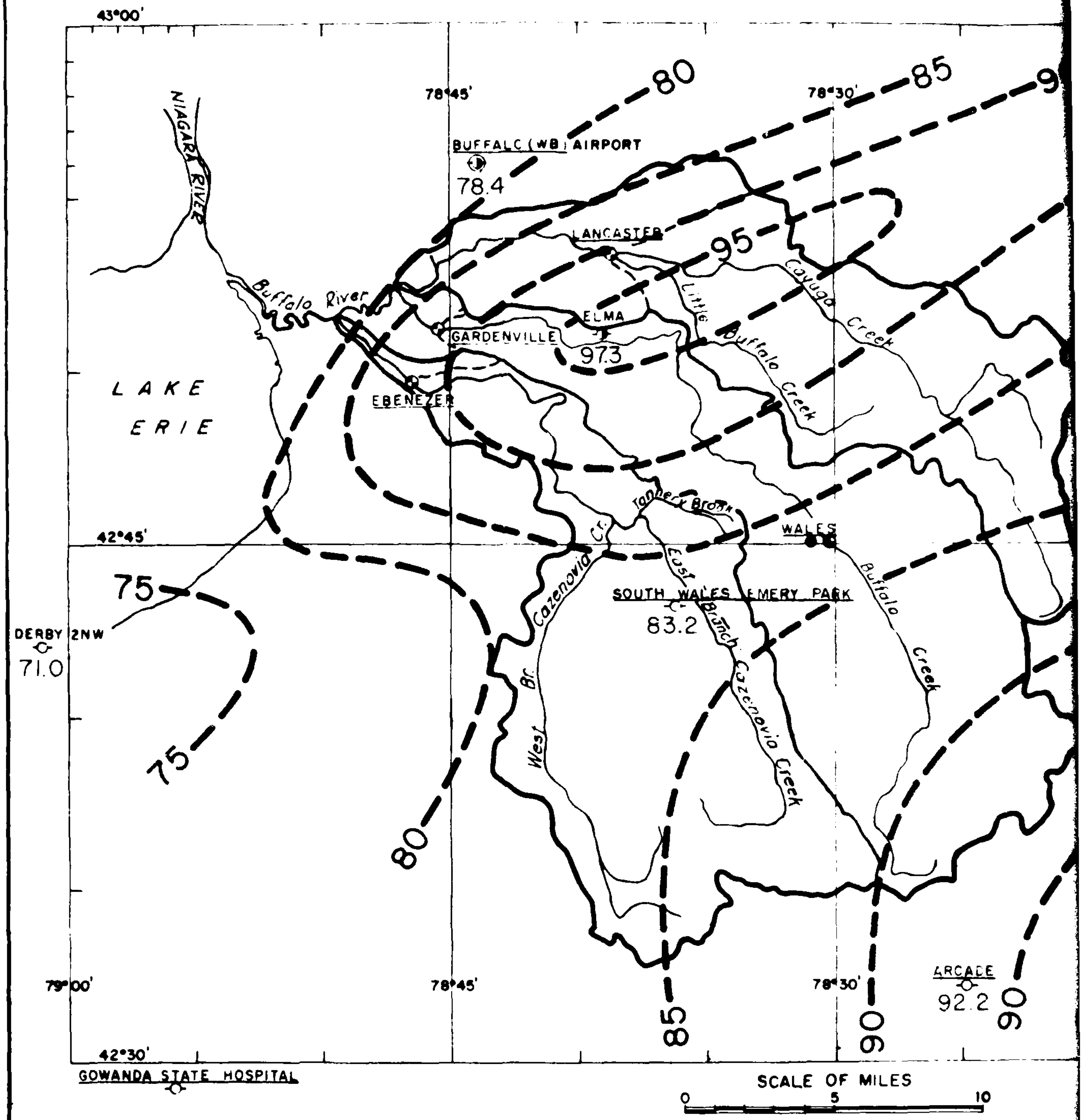


INCHES

CAZENOVIA CREEK, NEW YORK

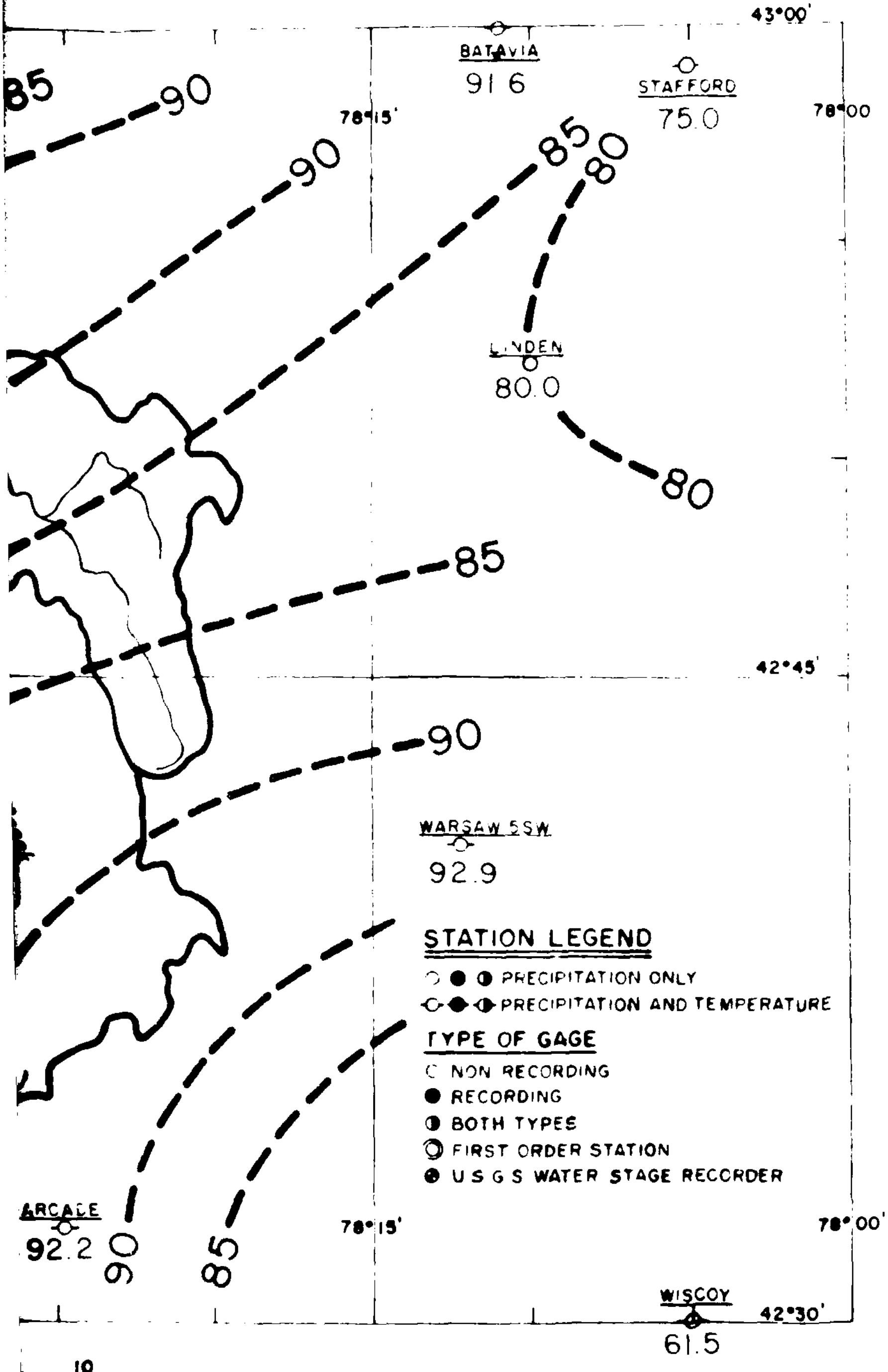
HYDROLOGIC STATION AND PRECIPITATION MAP

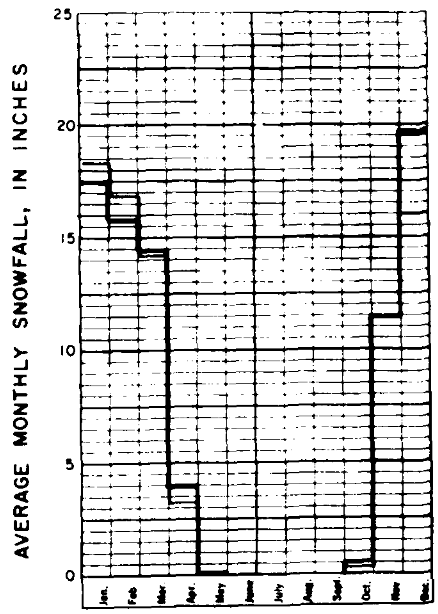
U.S. ARMY ENGINEER DISTRICT, BUFFALO



AVERAGE ANNUAL SNOWFALL IN I

1





GRAPH LEGEND

AVERAGE MONTHLY SNOWFALL FOR 10 STATIONS

AVERAGE MONTHLY SNOWFALL AT SOUTH WALES EMERY PARK

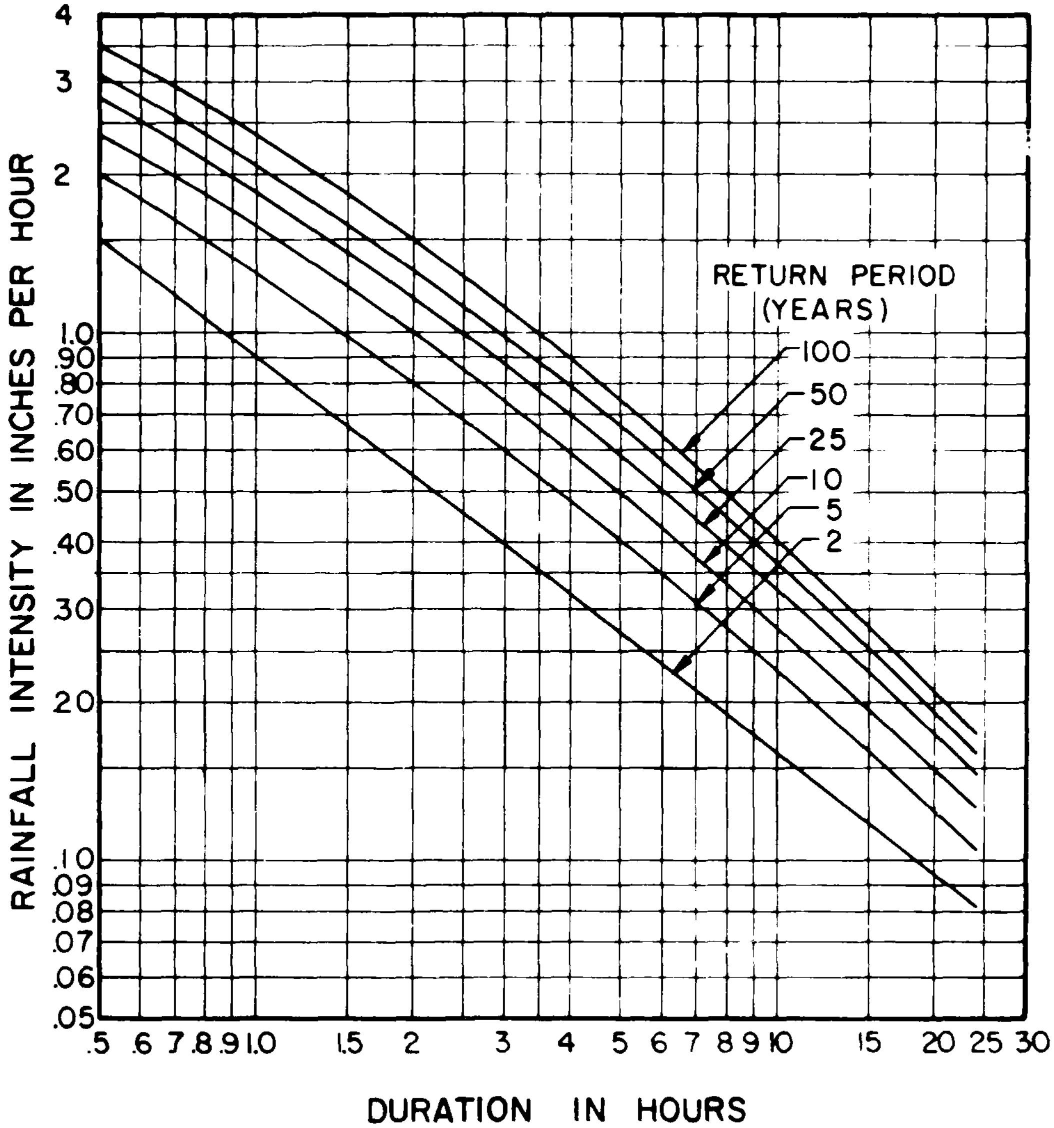
LL IN INCHES

CAZENOVIA CREEK, NEW YORK

SNOWFALL MAP

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE A2



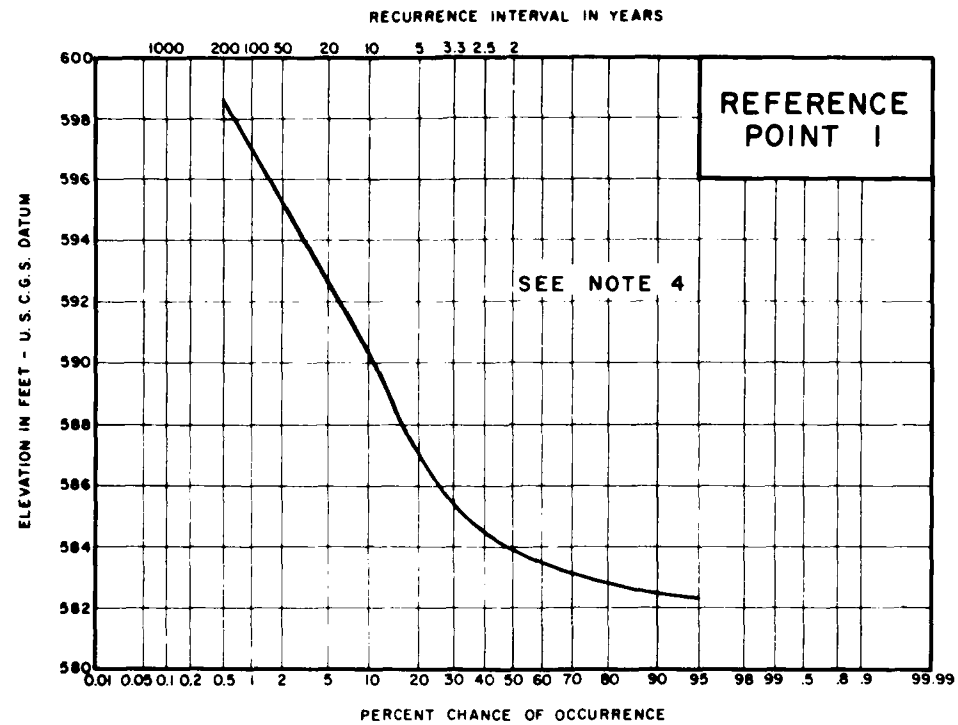
DERIVED FROM U.S. WEATHER BUREAU TECHNICAL PAPER NO. 40, "RAINFALL FREQUENCY ATLAS OF THE UNITED STATES"

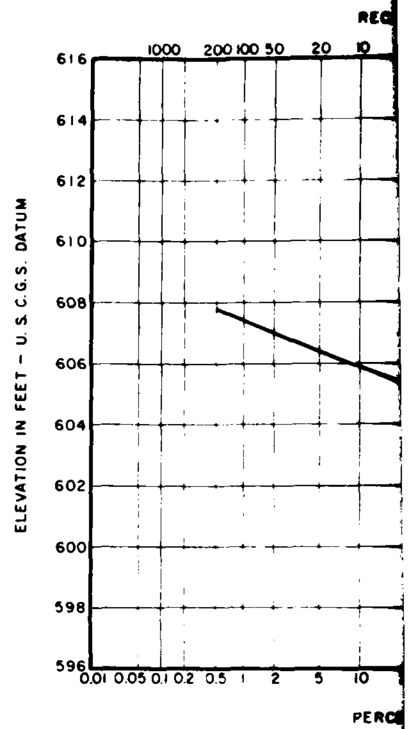
CURVES ARE APPLICABLE FOR ANY GIVEN POINT IN THE CAZENOVIA CREEK WATERSHED.

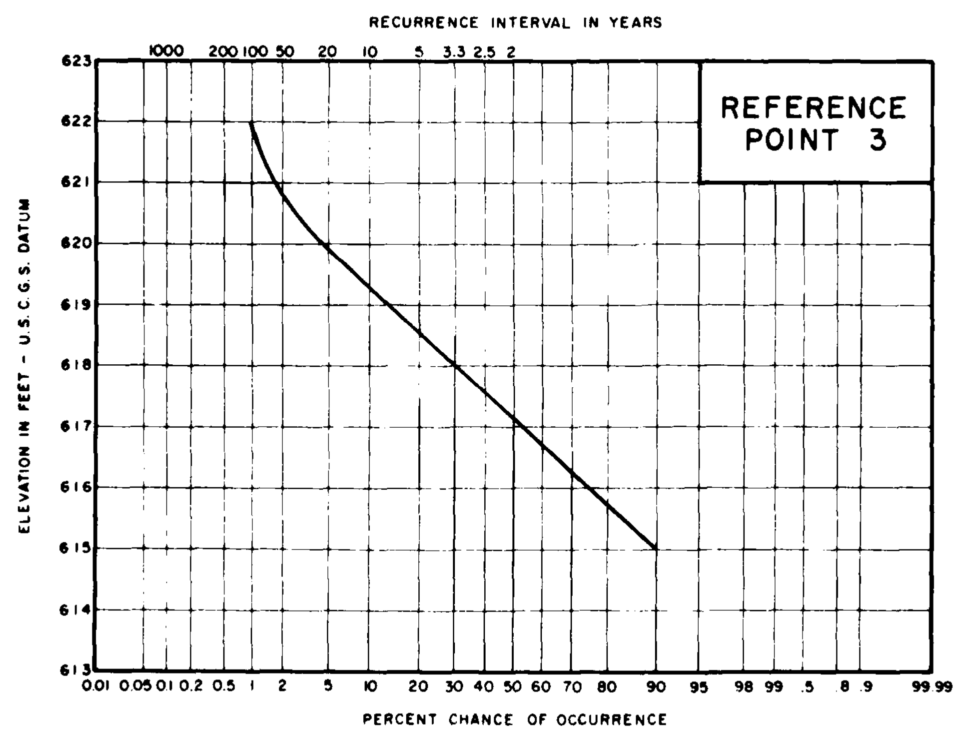
CAZENOVIA CREEK, NEW YORK

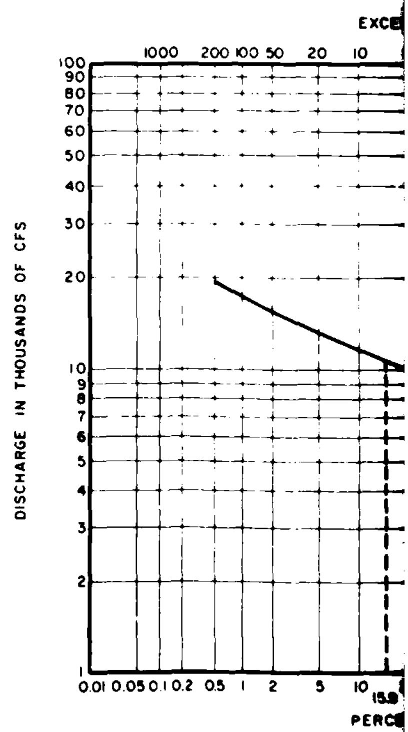
RAINFALL INTENSITY DURATION FREQUENCY CURVES

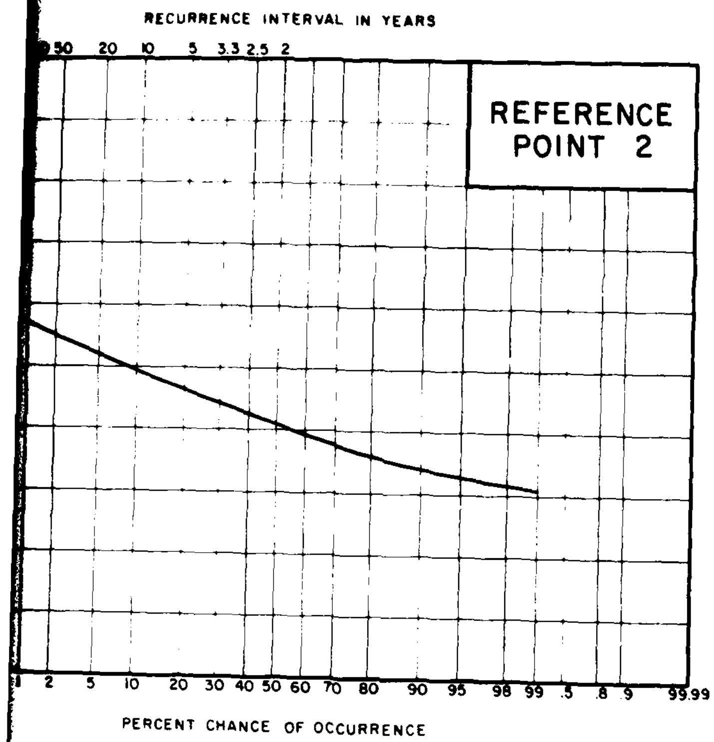
U.S. ARMY ENGINEER DISTRICT, BUFFALO

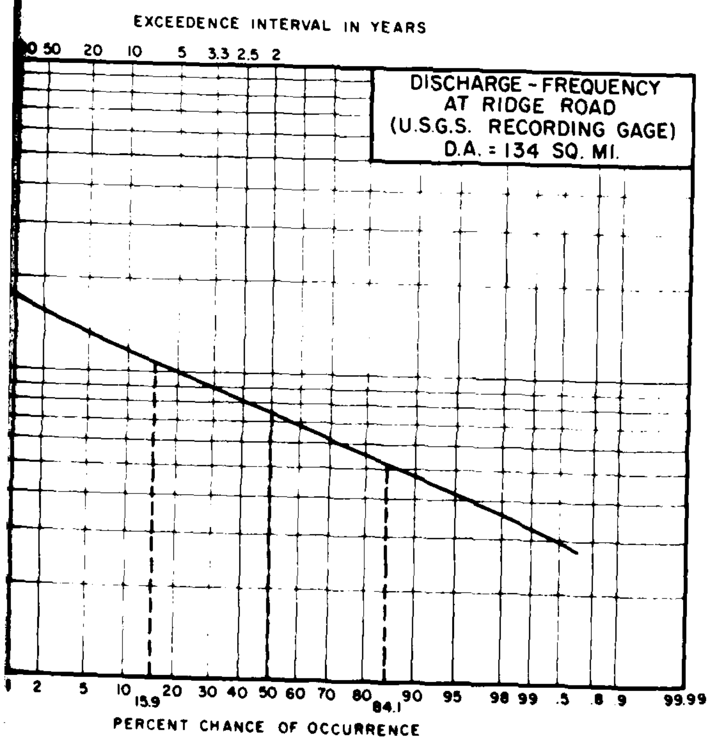

RECURRENCE INTERVAL IN YEARS
1000 200 100 50 20 10 5 3.3 2.5 2
REFERENCE POINT 1
SEE NOTE 4
ELEVATION IN FEET - U.S.C.G.S. DATUM
600 598 596 594 592 590 588 586 584 582 580
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 .5 .8 .9 99.99
PERCENT CHANCE OF OCCURRENCE


1000 200 100 50 20 10
ELEVATION IN FEET - U.S.C.G.S. DATUM
616 614 612 610 608 606 604 602 600 598 596
0.01 0.05 0.1 0.2 0.5 1 2 5 10


RECURRENCE INTERVAL IN YEARS
1000 200 100 50 20 10 5 3.3 2.5 2
REFERENCE POINT 3
ELEVATION IN FEET - U.S.C.G.S. DATUM
623 622 621 620 619 618 617 616 615 614 613
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 .5 .8 .9 99.99
PERCENT CHANCE OF OCCURRENCE


1000 200 100 50 20 10
DISCHARGE IN THOUSANDS OF CFS
100 90 80 70 60 50 40 30 20 10 9 8 7 6 5 4 3 2 1
0.01 0.05 0.1 0.2 0.5 1 2 5 10
15.9





NOTES:

1. LOCATION OF REFERENCE POINT 1 - UPSTREAM SIDE OF CAZENOVIA STREET BRIDGE.

2. LOCATION OF REFERENCE POINT 2 - UPSTREAM SIDE OF ORCHARD PARK ROAD BRIDGE.

3. LOCATION OF REFERENCE POINT 3 - U.S.G.S. RECORDING GAGE UPSTREAM SIDE OF RIDGE ROAD BRIDGE.

4. STAGE FREQUENCY CURVE IS BASED ON DATA COLLECTED BEFORE CHANNEL EXCAVATION BY THE CITY OF BUFFALO, STAGES WILL BE LESS FREQUENT IN THE FUTURE.

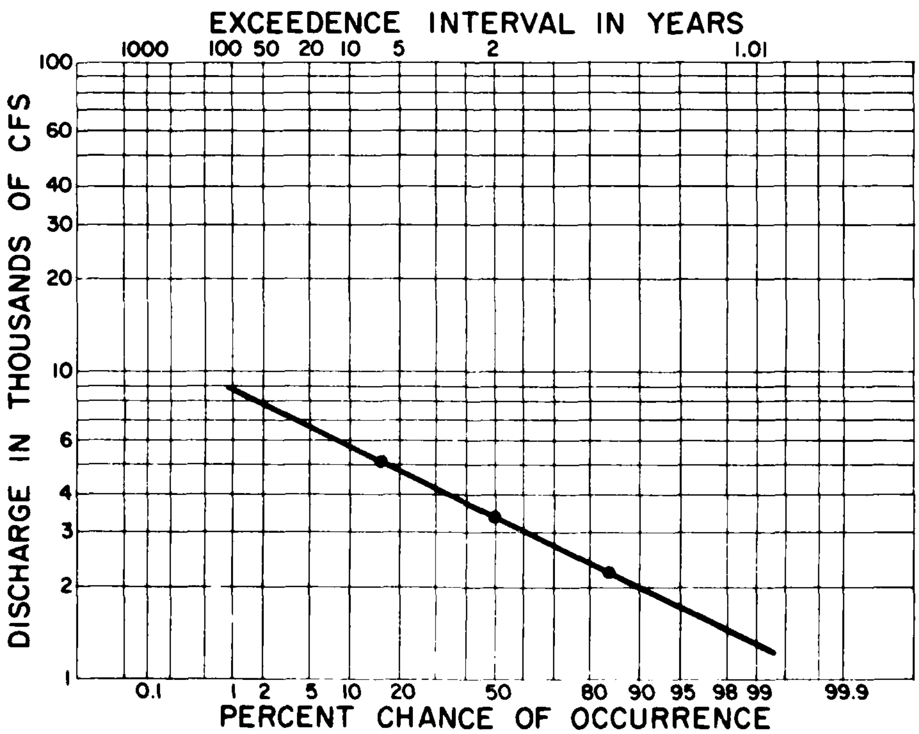
CAZENOVIA CREEK, NEW YORK

FREQUENCY CURVES

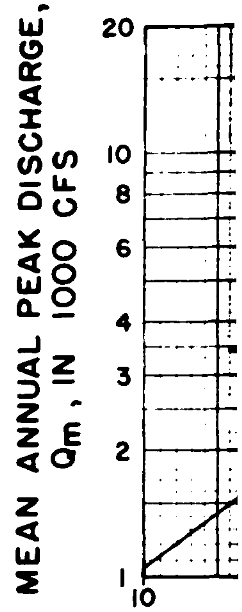
U.S. ARMY ENGINEER DISTRICT, BUFFALO

EXAMPLE: ◓ POINT OF INTEREST

1. DETERMINE DRAINAGE AREA OF BASIN ABOVE POINT OF INTEREST. (IN THIS EXAMPLE A = 50 SQ. MI.)
2. ENTER FIG. a WITH 50 SQ. MI., READ Qm, 3400 CFS.
3. ENTER FIG. b AT POINT OF INTEREST, INTERPOLATE FOR VALUE OF S, 0.17.
4. M = LOG Qm = 3.531.
5. LOG $Q_{15.9\%}$ = M + S = 3.701.
6. $Q_{15.9\%}$ = ANTILOG (3.701) = 5020 CFS.
7. LOG $Q_{84.1\%}$ = M − S = 3.361.
8. $Q_{84.1\%}$ = ANTILOG (3.361) = 2300 CFS.
9. PLOT $Q_{15.9\%}$, Qm, AND $Q_{84.1\%}$ ON LOGARITHMIC PROBABILITY PAPER, AS SHOWN BELOW. Qm IS PLOTTED AT 50% CHANCE OF OCCURRENCE.



NOTE: EXCEEDENCE INTERVAL IN YEARS IS DETERMINED BY DIVIDING 100 YEARS BY PERCENT CHANCE OF OCCURRENCE



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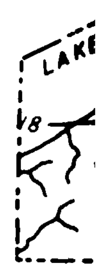

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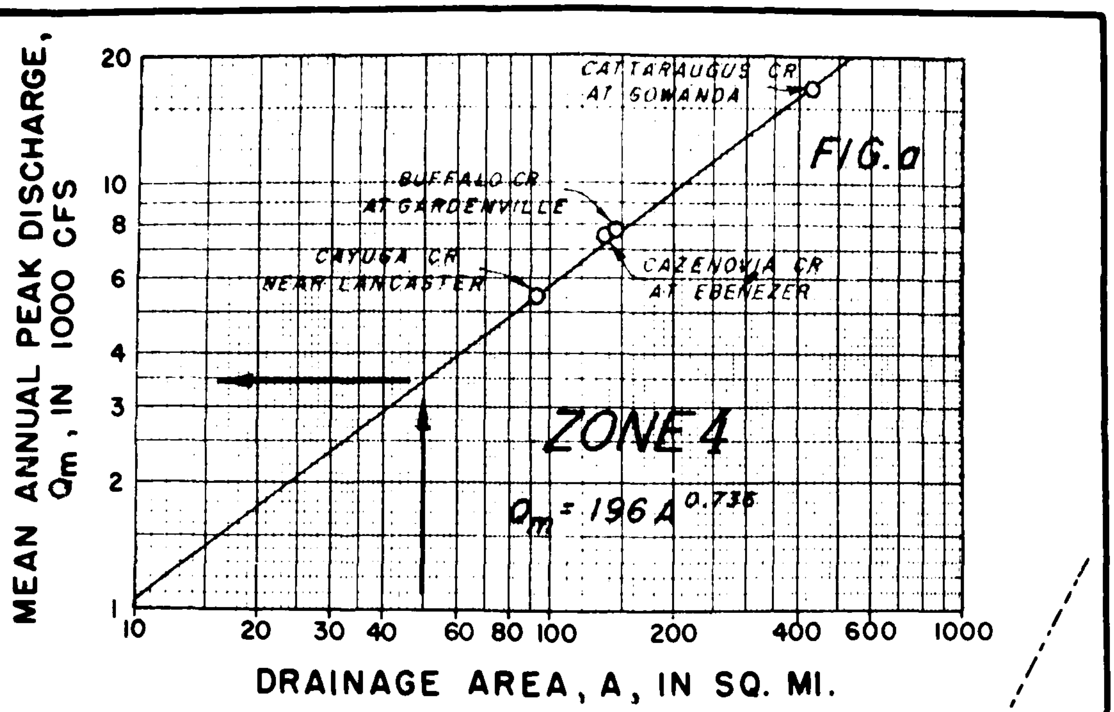
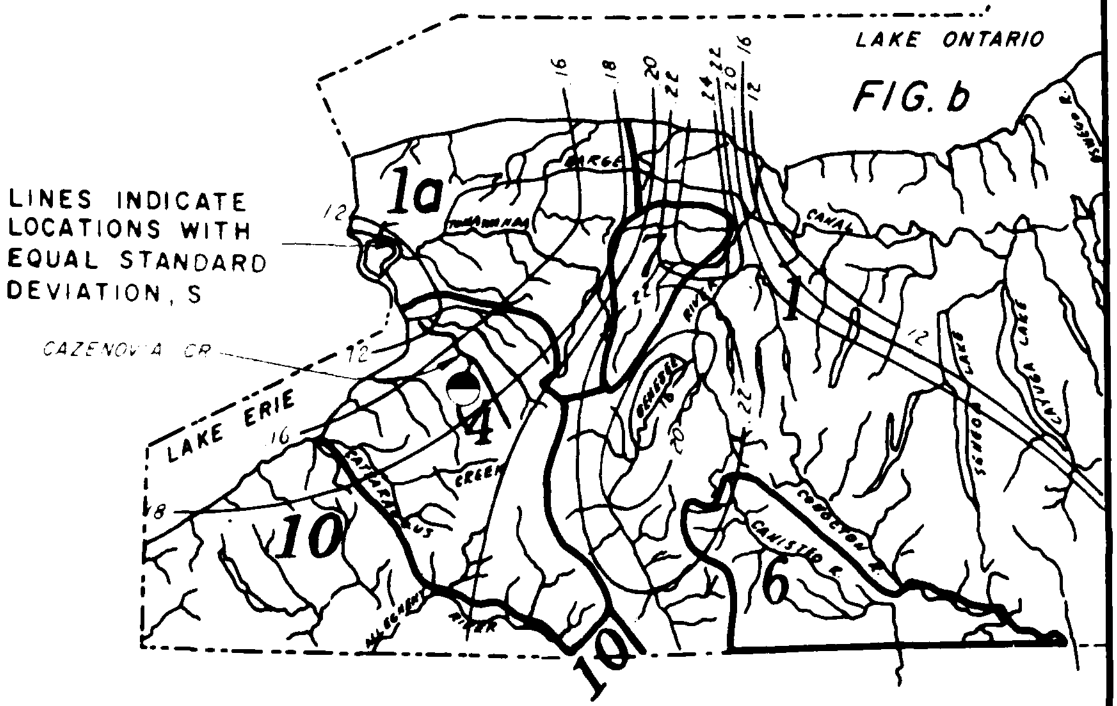
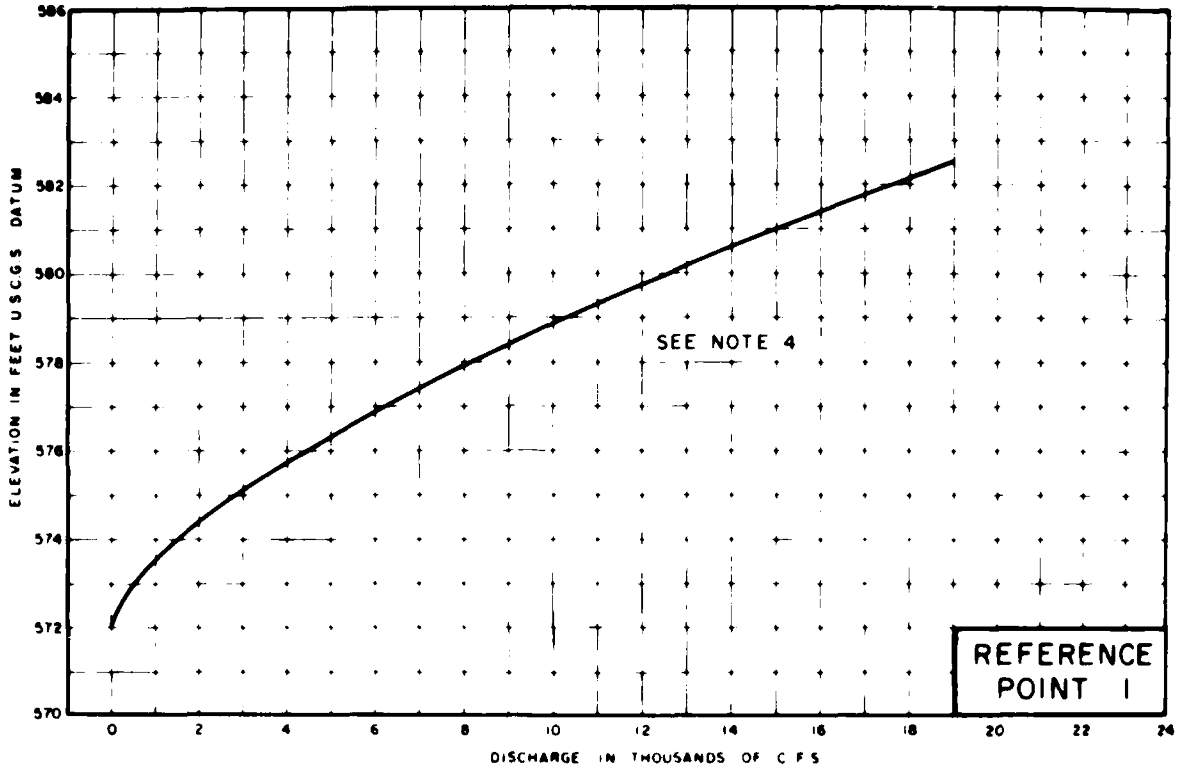


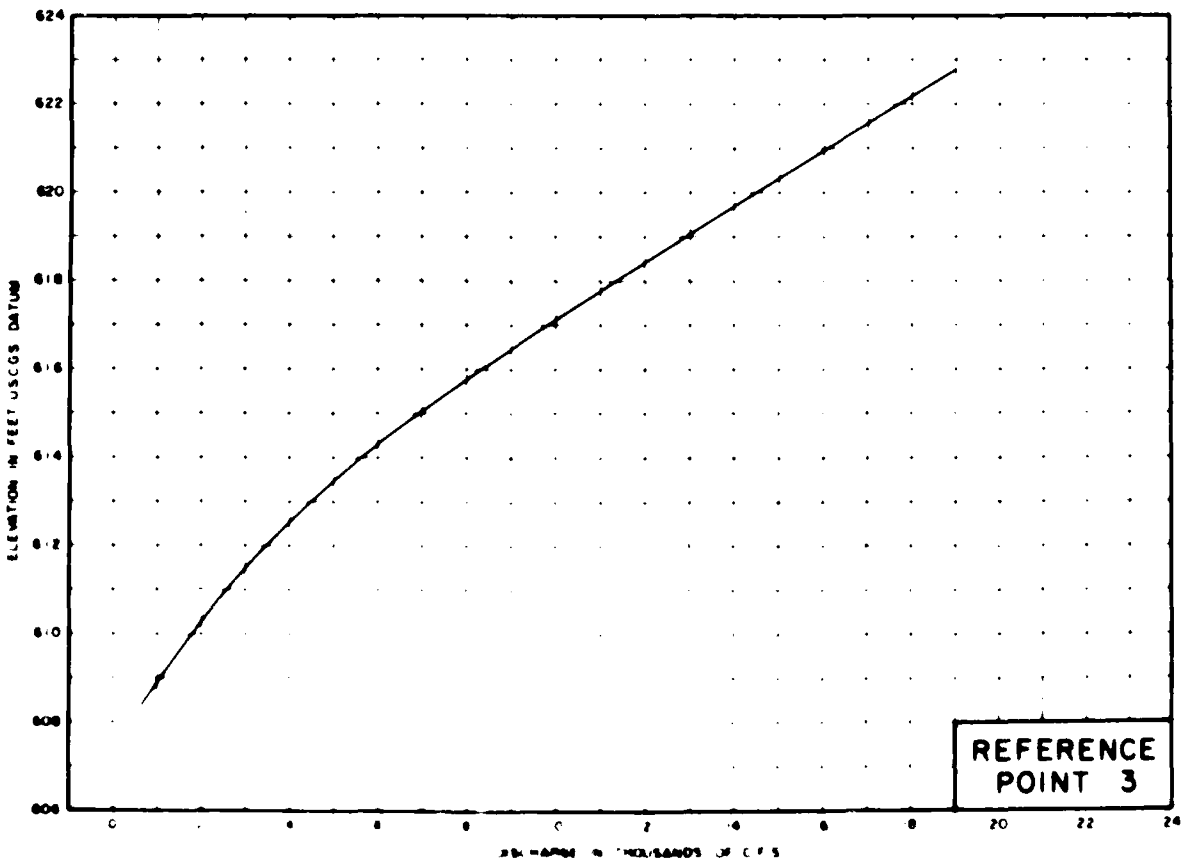


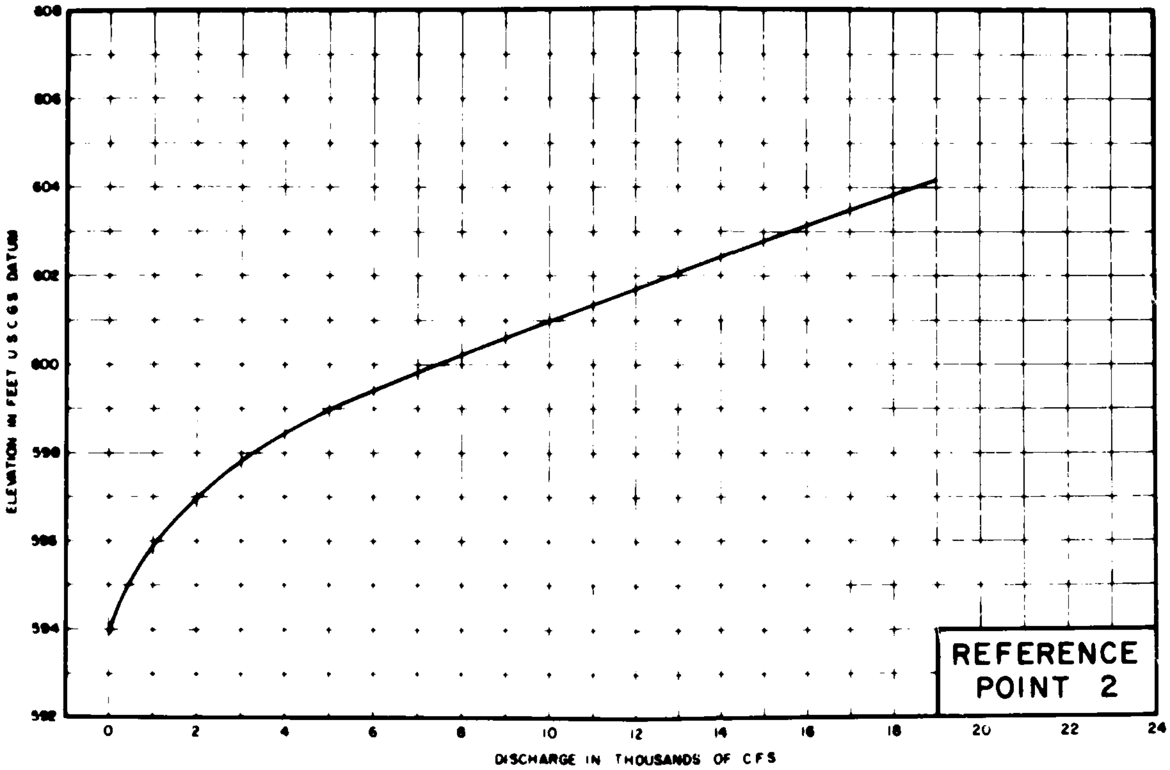
CAZENOVIA CREEK, NEW YORK

REGIONAL GENERALIZED DISCHARGE FREQUENCY CURVES

U.S. ARMY ENGINEER DISTRICT, BUFFALO


ELEVATION IN FEET USCGS DATUM
SEE NOTE 4
DISCHARGE IN THOUSANDS OF CFS
REFERENCE POINT 1


ELEVATION IN FEET USCGS DATUM
REFERENCE POINT 3



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3 LOCATION OF REFERENCE POINT 3 - U.S.G.S. RECORDING GAGE UPSTREAM SIDE OF RIDGE ROAD BRIDGE.

4 BASED ON EXISTING CHANNEL WHICH INCLUDES IMPROVEMENTS BY THE CITY OF BUFFALO.

CAZENOVIA CREEK, NEW YORK

STAGE - DISCHARGE CURVES

U.S. ARMY ENGINEER DISTRICT, BUFFALO

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